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AN EPISODE APPROACH TO UTILIZATION, COSTS, & EFFECTIVENESS IN HEALTH CARE

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AN EPISODE APPROACH TO UTILIZATION, COSTS, AND EFFECTIVENESS IN HEALTH CARE

HCFA Grant No. 18-P-97235/9-02

Final Report

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November 30, 1981

DEDICATION

To Jane Cassels Record

The death of Principal Investigator Jane Cassels Record in Feburay 1981 left a deep and profound sense of loss among all of her colleagues. She conceived this study, obtained funding, and shaped its execution. Her insight and intelligence were matched only by her rare personal charm and wit. This final report would undoubtedly have contained other thoughts and conclusions than it does, had she survived to supervise its completion. Nevertheless, it answers many of the questions she posed nearly three years ago when she first began to write the grant proposal. The results of this and her other investigations will influence health and medical care for many years to come. Those of us who were privileged to have worked with her will be affected for the remainder of our lifetimes. With deepest gratitude we dedicate this report to Jane Cassels Record.

ACKNOWLEDGMENTS

In addition to the individual investigators who produced sections of this report, a large number of people contributed substantially, and in some cases, heroically, to this effort. Grateful acknowledgment is extended to Marilyn McCabe, Dan Azevedo, and Dan Purcell for assistance in data programming, management and analysis; to Arnold Hurtado for his help in revising the RVS system; to Mary Ellen Devenport for assistance in using and interpreting the coding systems of the research medical records department; to Margaret R. Sucec for tireless editorial assistance; to Debbie Schoenheinz, Karen Stokes, Sharon Patterson, Evelyn Smith, and Phyllis Snedeker for exhausting clerical assistance; and to Kathleen Sinclair and Shelly Wiswell for preparation of the figures.

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SECTION I.

INTRODUCTION - ORIGIN AND PURPOSE OF THE STUDY

Health care economics has been difficult to study because of the problem in distinguishing between inputs and outputs. One of the major deficiencies--whether productivity, cost, or efficacy is being analyzed--has been the absence of a proper measure of what it is that delivery systems produce. Because of this conceptual weakness, an understanding of economic relationships in the health field has been severely limited. Attempts to develop cost functions, production functions, and the like have had to rely upon simplistic assumptions concerning the nature of the health system's output. Studies have confused output with input. A hospital bed day or an office visit has been designated as a unit of output. Intermediate services have been grouped together in an arbitrary fashion to describe the output of a particular hospital department, such as radiology. However, what has been lost in that approach is the fact that such services are all inputs.

When a bed day, an office visit, or a laboratory test is chosen as the output unit, the question most often asked tends to be how those particular services, in themselves, can be produced more economically, with the implicit assumption that the service inputs presently occur in the right number and combination. The essence of an episode approach to cost effectiveness is its challenge to that assumption. When the episode is selected as the unit of output measurement, a central question becomes how to economize the input bundle

(services and procedures rendered) as a whole, focusing on the substitution of one input for another where appropriate. Thus, the issue turns on finding the most cost-efficient combination of inputs or services to handle an episode of illness at an adequate level of quality. Are laboratory tests useful diagnostic or maintenance procedures which can replace office visits? Could better use of the telephone reduce walk-ins? These questions illustrate substitution possibilities which can be studied within an episodic approach to output measurement.

The existing literature in which episodes are developed as outputs is sparse. Solon, et. al.[1] described patterns of utilization by a small group of students. Berki[2] discussed the merits of using case management, rather than bed days or other inputs, as a way of looking at output; but his focus was upon inpatient care rather than upon an entire episode of care, which typically includes some outpatient visits or procedures even if hospitalization is the central input. Moreover, Berki's analysis was essentially nonempirical. Similarly, Ro and Auster[3] indicated the need for an episodic approach but contribute little to the stock of empirical knowledge.

[1] Solon JA, et. al. Episodes of medical care: nursing students' use of medical services. Am J Public Health 1969; 59:936-946.

[2] Berki S. Hospital economics. Lexington (Mass): Lexington Books, 1972.

[3] Ro K, Auster R. An output approach to incentive reimbursement for hospitals. Health Serv Res 1969; 4(3):178-187.

Scitovsky and McCall[4] took a major step forward through their attempt to assess the costs of illness episodes. They found wide variation in patterns of care over time, with a major secular shift toward greater use of ancillary diagnostic services as lengths of hospital stay declined. Though the authors' analysis was thorough, it centered on inpatient procedures and was constrained by the amount of data available.

Pineault[5,6] looked at the variant behavior of internists in the Kaiser-Permanente Medical Care Program (KPMCP) in Portland, Oregon with respect to the use of diagnostic and treatment procedures, but made no attempt to analyze the procedures within specific episodes of illness. It is not by chance that studies which broke methodological ground in such a promising way were not followed by larger-scale efforts to develop the episode methodology. Perhaps the chief explanation for the paucity of empirical research on episodes as output is the scarcity of data which permit clustering of health care inputs by episode.

Medicare data, for instance, have two drawbacks. First, Medicare does not cover all services. Second, not all

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[4] Scitovsky A, McCall N. Changes in the costs of treatment of selected illnesses 1951-1964-1971. Health Policy Program discussion paper, September 1975.

[5] Pineault R. The effect of prepaid group practice on physicians' utilization behavior. Med Care 1976; 14:21-136.

[6] Pineault R. The effect of medical training factors on physician utilization behavior. Med Care 1979; 15:51-68.

services which are covered are given by the same provider. Thus reimbursement records and procedures, which center on the provider rather than on the patient, make it easier to aggregate services by physician or hospital than by individual patient. However, it is the patient's complete record that is important for episode research. Perhaps even more serious than the deficiencies just described is the failure of the Medicare record to identify services by morbidity; thus several services given to an individual, simultaneously or serially, are not uniquely coded and therefore are not separable by complaint or diagnosis. Moreover, no-charge services such as phone calls typically do not get into Medicare records in any form; yet they are important inputs which should be included in the calculus of resource substitutability.

Medicaid, though its coverage is broader than Medicare's, has the same basic data deficiencies; and the same can be said generally of Blue Cross and Blue Shield. A fundamental flaw in virtually all third-party data systems, from the episodic point of view, is their inability to track individuals as they seek care over time and across delivery systems or providers. Medicare has the only data pool that follows persons geographically, across state boundaries, but nonelderly patients are weakly represented in Medicare data. Changes in employment status, employer, income, and locale make consistency and completeness of third-party coverage--and therefore third-party

records--highly uncertain. Patient records kept by individual physicians might be more complete, but numbers would be too small even if access to such records were possible.

The other major explanation for the slowness and sparseness of episodic research is the awesomeness of the methodological issues associated with definition of homogeneous episodes of illness. Two illustrations will suffice: (1) the establishment of the beginning and end points of an episode and (2) the standardization of cases for severity and/or complexity so that fundamentally similar episodes are compared. A related problem concerns associated or coexistent morbidities which alter the nature of the patient's complaint or status and therefore the nature of the episode. Even with a data set that provides information about relevant factors--age, sex, past medical history, other morbidities, and so forth--the task of achieving consistent definitions of homogeneous episodes is complex and difficult; without a comprehensive data set the task is impossible. It is the comprehensiveness of the data systems developed by the Health Services Research Center which, together with the Center's other resources, provided a promising setting in which to try to develop an episode approach to health care services and their costs.

This project is intended to be the first phase of a two-phase study to develop a methodology for analyzing episodes of care for common illnesses and conditions that consume large amounts of health care resources. The first phase will

establish episodes of outpatient care for a number of acute and chronic diseases. For the various illnesses identified, the different bundles of care used to diagnose and treat the episodes of various illnesses, from the least to the most costly, will be identified. The first phase will also attempt to determine if there are variations in treatment patterns among episodes with similar resource use or input costs. These analyses will be developed on the assumption that the quality of care for any observed treatment pattern is acceptable. Analyses will also be directed to identifying the patient, physician, and medical care process characteristics that best account for the variation in costs or resource use among episodes of care for the various illnesses.

The second phase will use the episode of care approach to address a variety of cost-sensitive policy issues in the health care field. Examples of the kinds of issues to which the episode approach to output measurement would make scientific investigation more effective are: 1) therapeutic issues which have significant cost impacts and need to be submitted to evaluative clinical trials; 2) the costs of prevention compared with the cost of care for episodes of preventable disease; and 3) the costs of early detection and treatment compared with costs of later detection and treatment.

SECTION II. THE SETTING OF THE PROJECT

This section of the report briefly describes the Kaiser-Permanente Medical Care Program, Oregon Region, the Health Services Research Center, and the data systems which were used to achieve the goals of this project.

The Kaiser-Permanente Medical Care Program, Oregon Region (KPMCP)

The Kaiser-Permanente Medical Care Program (KPMCP) is a federally certified health maintenance organization. The program in Portland, which serves as the medical care laboratory for the Health Services Research Center, was established in 1943 and now enrolls about 20 percent of the population of the Portland, Oregon and Vancouver, Washington metropolitan areas. The demographic and sociographic characteristics of the members of the KPMCP correspond very closely to the metropolitan population as a whole. Five basic principles shape the organization of this HMO: voluntary enrollment; prepayment for comprehensive benefits on a service basis; preventive medical care; integrated, hospital-based health care facilities; and provision of physician services through group medical practice. The Kaiser Foundation Health Plan contracts with the Northwest Permanente, Professional Corporation, Physicians and Surgeons to supply medical care and with the Kaiser Foundation Hospitals to supply hospital care.

The program maintains two hospitals: Bess Kaiser Medical Center, which has a 250-bed capacity, and the newer Sunnyside Medical Center, which has a 130-bed capacity. There are nine ambulatory care facilities located in various neighborhoods throughout the metropolitan area.

A single, comprehensive medical record maintained for every member of the program is stored in a central location. Every contact an individual makes with the medical care system is recorded on this unit chart. Whenever a patient has an appointment at a medical facility, his (her) record is delivered to the attending physician to be available at the time of appointment.

The system provides services performed by a broad range of medical specialists and other manpower, including physician assistants, pediatric nurse practitioners, nurse-midwives, clinic, hospital, and public health nurses, laboratory and x-ray personnel, physiotherapists, pharmacists, optometrists and mental health workers. A range of educational, screening, diagnostic, treatment, and rehabilitation services are available.

The prepaid benefits presently include coverage for physician, hospital, laboratory, and x-ray services, and immunizations and injections at a minimal out-of-pocket expense to the member. Coverage also includes partial benefits for mental health services and optical care. Drugs are provided at reduced charges and are prepaid for a significant proportion

of the population. An emerging dental program has been integrated into some groups' coverage.

Northwest Permanente, Professional Corporation, Physicians and Surgeons in Portland, Oregon is an independent professional corporation of board-certified or board-eligible physicians. These physicians, who practice full time in all the major specialties of medicine and surgery, compose the active staffs of the two hospitals. Support services are provided by departments of radiology, pathology, and physical medicine. The medical group receives a fixed capitation payment from the Health Plan to provide needed services.

KPMCP members are encouraged to choose a personal physician and to return to that same physician when the need for medical care arises. Family practitioners, internists, and pediatricians provide primary care and are responsible for maintaining continuity of treatment, including care for their patients while they are hospitalized.

The focal point for medical care is the physician's office, where most patients are seen by appointment, although provisions are made for walk-in patients. Emergency services are available at all hours, and house calls are provided for patients when medically indicated. In addition, home health and homemaker services are provided to patients requiring these services.

The Health Services Research Center

The Health Services Research Center (HSRC) of the Kaiser-Permanente Medical Care Program was responsible for

implementing the research project. The HSRC is an organizational unit of the KPMCP but retains a professional autonomy to ensure that the research environment adheres to the academic model necessary for the conduct of scientific research.

The Center brings experienced university- and Center-based researchers in various disciplines to a setting where extensive data are available from an operating medical care system that encourages health services research and evaluation. Studies have been directed toward the investigation of factors affecting medical care utilization.

Health Services Research Center Data Systems

The data systems of the HSRC have been developed to meet the specialized information requirements necessary to conduct medical care research relative to utilization and behavior of members and providers in a prepaid group practice setting. These data systems in some instances have been derived from the administrative record-keeping operations of the KPMCP and enhanced to fulfill research information needs. Other data systems, particularly the Outpatient Information System which served as the data base for the episode study, have been designed, developed, and maintained by the HSRC to investigate utilization of medical care services in defined populations served by the medical care program.

The Outpatient Information System

The Outpatient Information System was established to record extensive outpatient data on a 5 percent random sample

of KPMCP subscriber units. It began in September 1966 and is updated monthly. This continuously updated 5 percent sample provides populations for both cross-sectional and longitudinal studies. This study includes all outpatient medical care for the given conditions rendered between September 1966 and December 31, 1974. Data for subsequent periods was not available at the time this project was implemented.

The outpatient medical record is the source of information for this data system. This record contains information for the medical contacts a member has with the program, including office visits, drug orders or notations, emergency care, laboratory and radiology services, telephone calls, correspondence, and inpatient admissions. Whenever the medical record is removed from the central file and used by anyone in the program or whenever any information is entered into it, the medical record is checked to determine if it is included in a research study. The medical records of patients in various research studies are identified by a black box around the medical record number. These records are immediately routed to the Research Medical Records Department. The department's staff of medical record technicians and clerical personnel are responsible for the collection and processing of all information in a manner that least interrupts the routine flow of charts within the organization.

Detailed recording and coding instructions have been developed by the HSRC. The International Classification of Diseases, Adapted (ICDA, 7th Edition) has been expanded and

modified, particularly in relation to ambulatory care morbidity patterns, and is used to record diagnoses and symptoms. Services provided and procedures rendered are coded according to an adaptation of the 1964 California Relative Value Studies (See Section III). Providers of medical care services are uniquely identified through a coding system that details both the specialty of service or the provider as well as the identity of the individual provider. Drugs ordered are coded using a system developed by the HSRC. The codes identify the specific name of the product, its dosage form, and strength, if recorded. Additional information is recorded to describe the general instructions for drug use such as refill, discontinue, and decrease dose.

In the course of the data collection process, a variety of questions arise which cause the medical record technicians to seek clarification or interpretation of the medical record. To assist the technicians in this regard, physicians associated with the Outpatient Information System are routinely available for consultation. To further assure the reliability and validity of the data collected, monthly validity checks are conducted to test the standardization of the recording process, to introduce new or revised recording procedures, and to identify and resolve questions about the recording process.

A variety of forms are used in the data collection and maintenance processes of the Outpatient Information System. The basic encounter form, Form-A, is used to record every patient contact with the medical care system. The Form A is

used to record both descriptive characteristics of the encounter as well as diagnostic and treatment information. Drug notations are coded as a separate section of the Form-A. Laboratory and radiology services are recorded on the Form-B. These forms and others used in the system have been designed whenever possible to use precoded formats to enhance the ease and accuracy of the data collection process.

Completed forms for the Outpatient Information System are entered into the data base via a mini-computer system using cathode ray terminals. Each field of information is checked either by range or table lookup for valid codes and is further edited by cross-field relational and multivariate time edits. Records are accessible on-line for a period before they are removed to serial tape files. Changes and updates to the tape files are routinely batch processed.

Content of Outpatient Data System

The following describes the general content of the system and attributes of the system that have particular significance to the episode study.

Each encounter with the medical care system generates a unique patient record for the date of service and day's service number, which is the ordinal sequence of contacts on the same day. The characteristics of the contact and the provider of service are routinely identified. For each contact, a variable number of morbidities from one to nine may be treated. The morbidity is the basic unit of analysis within the system and has attached to it the specific clinical,

laboratory, and radiological services and drugs that are ordered as well as scheduled follow-up services. Because the diagnosis of a condition may change through time, two data fields, an initial and an UPDATED diagnosis are provided. The initial is the first clinical impression of the provider of service whereas the UPDATED, if different from the initial, reflects the final clinical judgment or diagnosis. Additionally, diagnoses are distinguished by the term PRESENTING as being the primary reason for a contact. All other morbidities noted in the chart are treated as coexisting morbidities not responsible for the contact. In this study the cost of an office visit was always charged to the PRESENTING morbidity. Services for other morbidities were charged to those conditions as appropriate. This is a critical distinction in interpreting the results of this study.

Each drug notation is linked to the specific condition or diagnosis for which it was ordered. Such a linkage allows for the examination of drug orders by such factors as morbidity, prescriber, and patient characteristics. The drug order recoding component of the Outpatient Information System was unavailable prior to January 1972.

The episode service morbidity number is a unique feature of the system that provides for the linkage of episodes of illness into a chronological progression of events. For example, treatment of an acute upper respiratory infection later developing into pneumonia which results in the prescribing of penicillin and an adverse drug reaction is an

episode of illness. The episode service morbidity number links those events together in chronological progression so that the process of treatment of the URI and its complications may be examined and the outcomes of the treatment process, such as pneumonia and the adverse drug reaction, may be identified.

KPMCP Membership Information and the HSRC Calendar File

These two interrelated information systems also contributed data for the episode study. The membership information system maintained by the Oregon Region of the KPMCP identifies currently eligible members and is intended to serve administrative functions within the organization. Because of the financial role of this system in the dues collection and maintenance process, the system's orientation is to the member's most recent period of eligibility. This results in the loss of any previous eligibility information. To overcome this limitation and provide a continuous historical record of eligibility for every individual included in a research study, the Calendar File System was developed by the HSRC. Because the Calendar File is derived from the KPMCP membership system, the two systems are generally similar in content.

The KPMCP system and the Calendar File record the following information for each individual:

1. Medical record chart number
2. Health Plan I.D. number, consisting of a subscriber or family number plus an individual number

3. Patient name
4. Sex
5. Date of birth
6. Health Plan effective date
7. Effective date of current eligibility and, where applicable, termination date of eligibility and reason for termination
8. Class code or type of coverage
9. Group number or employer
10. Medicare eligibility
11. Zip code and address.

The Calendar File system interfaces on a monthly cycle with the KPMCP membership system to record changes for any individual included in a research population. When changes in eligibility characteristics are identified, the previous record of characteristics is closed with the previous month's date and a record of the new characteristics opened with the current date. Structured as a "FROM DATE-TO-DATE" description of eligibility characteristics, the Calendar File provides a detailed monthly eligibility history of every individual included in a research population. The availability of detailed population-at-risk data through the Calendar File is an integral part of the HSRC research data systems.

SECTION III. RESEARCH DESIGN

Overview

The study focused upon three basic problems in the analysis of an episode of care for an illness or condition. The three were: 1) identifying the alternative responses of the medical care system to that illness or condition; 2) accounting for any differences in response through analysis of specific characteristics of the patient, the provider, and the medical care system; and 3) identifying the resource use implications of those response differences.

Some 35 medical conditions were initially considered and were eventually subjected to detailed episode analysis. The criteria for judging the suitability for analysis of the conditions were: 1) Was the condition identifiable in episode form? 2) Were alternative bundles of acceptable-quality care potentially present? 3) Were numbers of episodes sufficient to permit necessary stratifications and adjustment? 4) Were there cost differentials in the potential alternative bundles of care and could those differentials be identified and analyzed?

This effort was viewed as a first phase approach to the problem. The available data were used to test a methodology for dealing with these questions. If the methodology could be satisfactorily developed, it was planned to select the two or three conditions most amenable to detailed study and subject them to an in-depth second phase study at a later time. Such

a study would likely include a detailed review of medical records.

Because the study involved elements of economics, medicine, biostatistics, epidemiology, sociology, and other disciplines, an advisory panel was formed to aid in making the important decisions required. This panel consisted of the following persons:

Jane Record, Ph.D., Economist, Principal Investigator

Thomas M. Vogt, M.D., M.P.H., Epidemiologist, Co-Principal Investigator

Rhesa Lee Penn, B.A., Special Research Assistant

Marilyn McCabe, B.A., Special Research Assistant

Richard Worthington, M.D., Family Practitioner, KPMCP

Richard Johnson, Ph.D., Pharmacy Administration, Sr. Investigator

Daniel Azevedo, B.S., Manager of HSRC Data Operations

Michael McCally, M.D., Associate Chief of Staff for Education, V.A. Hospital, Portland, OR

Herman Frankel, M.D., Pediatrician, Sr. Investigator,

John Mullooly, Ph.D., Biostatistician, Sr. Investigator

This panel was joined on occasion by other advisory personnel. During the summer of 1980, two medical students worked with the group in the preparation of reports.

The panel met weekly from the start of the study, and all major decisions regarding procedures and assignment of tasks were made in these meetings. The panel began its work by reviewing the literature and developing a file of papers relevant to the study. This work served to create a common

understanding among members of the group as to the aims and the complex nature of the study.

Criteria for Selection of Medical Conditions

Given that a condition seemed suitable for analysis, the project panel developed four additional criteria that were necessary for a medical condition to be considered for inclusion in the study.

1. Can there be homogeneity in the disease identified, so that differences in treatment modes reflect therapeutic choices for the same condition rather than differences in the condition itself? That is, can the condition be defined with enough precision with respect to severity, onset and termination of episode, associated morbidities, etc., to permit valid comparison of treatment modes for the condition?

2. Are there clearly identifiable, medically respectable, alternative modes of treatment for the condition?

3. Are there significant cost differences between or among modes?

4. Is frequency of the condition sufficient to yield adequate samples given the nature of the available data?

The original 35 conditions discussed by the group as potential candidates for inclusion in the study were:

1) Normal pregnancy to delivery
2) Delivery to two weeks post partum
3) Breast cancer
4) Myocardial infarction
5) Otitis media
6) Duodenal ulcer
7) Pneumonia
8) Gonorrhea
9) Chest pain

10) Headache
11) Anxiety-tension syndrome
12) Abdominal pain
13) Non-specific urethritis
14) Monilia vaginitis
15) Hypercholesterolemia
16) Fever of unknown origin
17) Infantile colic
18) Depression
19) Acute cystitis
20) Breast mass
21) Hypertension
22) Influenza
23) Tendonitis-bursitis
24) Obesity
25) Diabetes
26) Pharyngitis
27) Birth control
28) Angina pectoris
29) Uterine fibromata
30) Non-specific vaginitis
31) Dysmenorrhea
32) Acne
33) Low back pain
34) Hemorrhoids
35) Cholelithiasis

From this list, 18 conditions were selected as the best candidates, and data were retrieved for each. Review of data resulted in the rejection of four of these because the condition could not be defined with sufficient exactness (anxiety-tension and chest pain) or because there were insufficient numbers (ulcer and myocardial infarction).

Analysis was begun on the remaining 14 conditions. The analysis of three conditions was deferred (pregnancy/delivery, and post partum care, diabetes, and cholelithiasis).

The 11 conditions selected for detailed analysis were:

1) Acute cystitis
2) Headache
3) Breast lump
4) Shoulder bursitis

5) Depression
6) Fever of unknown origin
7) Gonorrhea
8) Hemorrhoids
9) Hypertension
10) Obesity
11) Otitis media

b. Episode definition

Episodes of care were operationally defined in the following manner. Episodes began at the first contact where a specific morbidity diagnosis was made or where the diagnosis was updated as a result of subsequent information. That is, if an individual came to a medical office complaining of stomach pain and no diagnosis was made at the first visit, but later as a result of further testing, a diagnosis of ulcer was made, the episode of ulcer would be updated to begin with the first contact for stomach pain. That data field would be updated to indicate that at a subsequent time a diagnosis of ulcer was made for that condition.

The definition of an episode differed for acute and chronic diseases. Acute conditions were usually considered a new episode when the condition recurred 90 days or more from the last date of service and there was no indication in the medical record of continuity with a previous condition. Upper respiratory conditions were considered new episodes if they recurred after more than 30 days. The timing of the clinical course of acute diseases often required medical evaluation and was verified by the medical staff before being entered into the computer record.

Chronic conditions consisted of a single life-long episode. Thus, any contact for a given chronic disease was always related to any prior contacts for the same condition. Such conditions were better analyzed in terms of utilization per unit time rather than as total episode utilization.

For the purposes of this study, the operational definitions of episodes were retained in some cases and not in others. Departures from the standard definitions are described in the individual disease reports.

Definition and Measurement of Resource Use

Resource use in the diagnosis and treatment of episodes of disease is measured by an adaptation of the 1964 California Relative Value Studies (CRVS). This section outlines the structure of the CRVS and the adaptations which were made in an effort to permit the estimation of total costs for entire episodes of medical care.

The CRVS was first issued by the California Medical Association in 1956. It was a comprehensive, standardized listing of both outpatient and inpatient laboratory, radiology, surgical, and medical procedures. Attached to each procedure name was a unit value, expressing in non-dollar terms the value of that procedure relative to others of the same type: medical, surgical, laboratory, and radiological. For each section, unit values were determined by a committee of physicians in the given specialty, which examined prevailing relative market prices for the procedures, and which judged the

relative time and professional skill required to complete a given procedure. Procedures were given a specific unit value, or a value equal to the sum of the values of the subcomponents of the procedure. Those procedures which required case-by-case valuation were indicated by a special code.

The objective of the listing, as stated in the introduction to the 1956 edition of the CRVS, was to develop a standardized list of procedures and their relative values, as agreed upon by physicians, that could be used by health care providers, consumers, and third-party payers. With such relative values, insurers and consumers could plan insurance coverage and reimbursement levels.

Revisions of the CRVS were published in 1960, 1964, 1969, and 1974. These incorporated new procedures and changes in relative procedure prices due to technological changes. The CRVS was the first comprehensive, physician-produced relative value scale; as such, it has been used as is or adapted by 20 state medical societies numerous government agencies, major insurance companies, and medical specialty organizations. No new CRVS value list has been published since 1974, under the terms of an antitrust consent decree between the California Medical Association and the Federal Trade Commission. However, the 1964, 1969, and 1974 CRVS guides remain in use.

When the HSRC outpatient information system was started in 1966, the 1964 CRVS procedure codes were chosen as the

basis for identification of medical procedures. Where the 1964 CRVS did not specify a procedure that occurred within the sample records, or where a new procedure had evolved since 1964, the HSRC staff and Kaiser-Permanente physicians cooperated in assigning codes and unit values to new procedures. This process occurred on a case-by-case basis from 1966 to 1979, with no overall review of the internal consistency of the values assigned to new procedures, or of the relationship between these values and values for comparable procedures given in the 1964 RVS. As a result, the existing list of procedures and values had numerous inconsistencies. To correct these problems, the episode advisory panel and a research physician cooperated in revising the entire listing of procedures and their values.

The method used in deriving procedure values for the HSRC's adapted relative value system (RVS) involved the following steps.

1. Where procedures and code numbers used by the data system coders were the same as those in the 1964 CRVS guide, the 1964 CRVS values were always accepted in order to maintain comparability and continuity of procedure coding over the entire period covered by sample data.

2. Many procedures included in HSRC data system coding were not defined in the 1964 CRVS. The following approach was used to assign values to such procedures.

California Blue Shield published a manual correlating 1964 CRVS values and 1969 CRVS values; if a procedure was assigned a 1969 CRVS value but not listed in the 1964 edition, a value in 1964 units was generated. (1964 and 1969 CRVS values are not directly comparable, due to a change in the basis of computation of CRVS units in 1969.) The HSRC used this manual[1] to assign 1964 unit values to many laboratory, radiology, nuclear medicine, and surgical procedures. This maintained the consistency with other procedures that were valued from the original 1964 CRVS.

There were, however, numerous common procedures not coded in either the 1964 CRVS or the 1964/1969 Blue Shield converter. For these procedures, Dr. Arnold Hurtado, KPMCP Area Medical Director, provided an estimate of the provider time and skill involved in giving the service. Each procedure was evaluated by the amount of resources used in giving the service, relative to these benchmark procedures:

Code 9001 - Initial physician office visit for new illness - 2.0 units

Code 9002 - Routine follow-up physician office visit - 1.0 unit

Code 9003 - Complete physical exmination - 3.5 units

These procedures were chosen as standards of comparison because they were the most common procedures in the outpatient data system. If there was uncertainty concerning the relative complexity of a procedure, advice was sought from

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[1] California Blue Shield, 1964-1969 RVS Correlation Manual, unpublished internal document.

physicians who regularly performed the procedure. (In the 1964 CRVS, medical office visits are coded at nine different levels of complexity; unit values vary accordingly. These were reduced to three separate codes for the HSRC adaptation, since information available to chart abstractors did not allow them to make finer distinctions on the length and complexity of an office visit.)

The application of the method just described left relatively few procedures that could not be given 1964 CRVS unit values. Those remaining were given unit values in the following manner.

The 1974 CRVS was used to give a 1964 CRVS unit value to radiology procedures developed after 1969. A weighted average method[2] was devised to convert 1974 CRVS units into 1964 CRVS units. It showed that 1.4 1964 CRVS radiology units equaled one 1974 CRVS radiology unit, including the professional fee.

The use of the weighted average method for 26 laboratory procedures occurring over 500 times in the outpatient data showed that 10 1974 CRVS laboratory units roughly equaled one 1964 CRVS laboratory unit.

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[2] The "weighted average method" is a procedure for converting dollar values or 1969/1974 RVS units into 1964 RVS units. To convert radiology 1974 CRVS units into 1964 CRVS units, 23 radiology procedures were chosen which occurred over 200 times in the five percent sample, and which had definite values in both the 1964 and 1974 CRVS books. For each procedure, the number of occurrences was multipled by the 1964 CRVS value; this was repeated for 1974 CRVS values. Then, the total numbers of 1964 RVS units for each procedure were added together. The same was done for 1974 unit values. The last step was the division of total 1974 units for these procedures into total 1964 unit values for them, to arrive at a conversion ratio.

For surgical procedures, two methods were used. If the procedure "X" with an unknown 1964 CRVS value had a known 1974 CRVS value, X's 1974 CRVS value was divided by the 1974 RVS value of a comparable procedure "Y", if Y had a known 1964 CRVS value. The ratio of the two procedures' 1974 CRVS values, in conjunction with the known 1964 CRVS value of procedure Y, allowed estimation of a 1964 unit value for procedure X. Also, use of the weighted average method with the 22 surgical procedures which occurred over 100 times and had known 1964 and 1974 CRVS values showed that 6.4 1964 CRVS units equaled one 1974 CRVS surgical unit. Proposed values for a new procedure were made using both methods, and that value which the physician advisors agreed was most accurate was selected.

If none of the above methods yielded a value for a procedure used during the 1966-1973 study period, the 1970 and 1979 Oregon KPMCP fee-for-service schedules were used. Unlike the CRVS, which had relative values based on a validated survey of a large market over a number of years, the KPMCP fee schedules for nonmembers were drawn up by a community provider survey. These fee schedules were used only as a last resort in deriving relative values and apply to only a small proportion of KPMCP patients.

The 1970 nonmember fee list was used to derive 1964 CRVS values. The authors of the list specified that an $8 medical office procedure for adults was worth one 1964 medical CRVS

unit; a one-unit pediatric procedure cost $7; a one-unit surgical procedure was worth $6.50. (These values were based on then-current Oregon Workmens' Compensation reimbursement schedules.) Use of the weighted average method for 25 laboratory procedures which occurred over 500 times in the outpatient sample and had known 1964 CRVS unit values and nonmember fees showed that a one-unit laboratory procedure cost $7.60. The weighted average method for 20 radiology procedures which occurred 200 or more times showed that one 1964 radiology CRVS unit cost $7.10 in nonmember fees. If the procedure was not listed in the 1970 nonmember fee list, the 1979 nonmember fee list was used.

These methods produced an updated version of the 1964 CRVS, adapted to the requirements and peculiarities of Health Plan data. (This version is hereafter called the RVS.) Each RVS value was to express the provider time and skill needed to perform a procedure, relative to the time and skill required to perform other laboratory, medical, surgical, or radiological procedures. Overhead costs were not considered in calculation of RVS values; the overhead cost per procedure was assumed to be proportional to the RVS unit value. Since the data base was outpatient medical records, no RVS values were constructed for inpatient nursing, bed-days, or medical procedures. Drug order data were available in 1972 and subsequent years. There were sufficient episodes of otitis media to allow analysis of drug costs. This was accomplished by

calculating RVS values for drug orders, using a method explained in the section on episodes of otitis media. Injection costs covered supplies and labor, and not (except with Rho Gam) the cost of the drug injected.

The HSRC relative value scale (RVS) has five types of pro-edure units: pediatric medical, adult medical, surgical, radiology, and laboratory.

Pediatric medical procedures were pediatric walk-in medical office visits and well-child physical examinations. Many contacts by patients under 18 years of age, with a pediatrician or with other providers, received procedure codes that were applicable to adults as well as to children. Adult medical procedures included office visits, immunizations, care by home health aides, telephone calls, letters, eye examinations, physical therapy, and mental health care. The HSRC RVS followed the practice of the 1964 CRVS in having one pediatric medical unit equal in value to one adult medical unit.

In other respects, the RVS also followed the unit distinctions set forth by the 1964 CRVS. Surgical units were given to outpatient surgical, orthopedic and endoscopic procedures. Tests on blood, urine, feces, and spinal fluid received laboratory unit values. Diagnostic and therapeutic radiation and ultrasound therapy received radiology units.

The authors of the CRVS warned that medical, surgical, radiology, and laboratory units were not comparable in value,

due to different overhead costs. However, a Senate subcommittee study of the CRVS indicated that

> the reasons for this division into four sections were probably as much political as any other. This resulted from the need for acceptance of the CRVS by the entire California Medical Association membership and the medical profession in general, and the protection of the interests of the various specialty groups.[3]

It was also learned from people who were involved in creation of the CRVS that the division of the CRVS into four segments was an artifice, done in part to reduce the risk of antitrust prosecution.

Therefore, in creating a measure of total resource use for the episode project, all four types of RVS units were summed to get a total RVS unit measure. For acute illnesses, total RVS units was the resource use measure chosen; for most chronic illnesses, the rate of RVS units per episode-year was used. RVS units were used as the unit of resource use for conditions analyzed early in the preparation of the report: cystitis, obesity, fever of unknown origin, bursitis, and otitis media.

Creation of a Dollar-Based Measure of Resource Use

When the HSRC list of procedures and RVS unit values was updated, a measure of the cost to the Health Plan of producing a unit of each type of service was developed. This was designed as an alternative overall measure of resource use for

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[3] Permanent subcommittee on investigations of the Committee on Governmental Affairs, United States Senate, The California Relative Value Studies, An Overview; pp. 92-93, April 1979, 90th Congress, first session.

episodes of care, and to check whether or not the costs of producing the different types of RVS units were similar. It was found that medical (surgical, adult medical, and pediatric medical) RVS units cost the Health Plan $5 per unit in 1970.[4] This figure included labor, supplies, and overhead costs of all types. Outpatient laboratory and radiology RVS units cost the Health Plan $3 per unit in 1970. Diseases in the process of analysis at the time of generating the dollar cost of an RVS unit were completed with dollar cost as the overall resource use variable. These conditions are: hypertension, hemorrhoids, gonorrhea, depression, breast lump, and headache.

The difference in dollar costs per RVS unit suggested that using total RVS as the measure of resource use might overstate the contribution of diagnostic procedures to total costs of episodes of care.

To examine the extent to which choice of dollars or RVS units as the measure of resource use affected definition of bundles of care, hypertension was selected for analysis because it has the highest proportion, 56 percent, of total RVS units assigned to laboratory and radiology procedures of any diseases examined. Thus, it was expected that the hypertension analyses would be most likely to show the effect of choice of the two resource use measures on identifying bundles of care. Table 3-1 shows the predictor variables used in both analyses.

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[4] The method for calculating the dollar costs of producing RVS units is described in Appendix I.

Utilization variables explained 69.6 percent of variation in hypetension dollar costs per year, and 62.7 percent of variation in hypertension RVS units per year (Figures 3-1 and 3-2). In both analyses, the first groups defined were those with, or those without, four or more followup office visits per year; of the total variation in resource use explained, approximately two-thirds was explained by this variable. The two costliest bundles were defined by office visits per year when dollars were the resource use measure, and were defined by laboratory tests when RVS units were the resource use measure. In the analysis using dollars, 37.5 percent of the variation was accounted for by laboratory or radiology procedures, using RVS units, 50 percent of the variation was accounted for by laboratory or radiology procedures.

Figures 3-3 and 3-4 show the analyses for hypertension, using patient, provider, and medical care process variables. The variables are listed in Table 3-2. For the highest resource use episodes, those beginning in 1972-1973, the patient, provider, and medical care process variables that defined the bundles of care were identical whether dollars per year or RVS per year was the resource use measure. For the lower resource use episodes, which began in 1971 or earlier, the next most important variable in both analyses was whether or not at least 25 percent of contacts for hypertension occurred at general physical examinations. Therefore, of the total variation in resource use explained, approximately four-fifths was explained by these identical variables.

These results indicated that use of RVS units instead of dollars for hypertension resource use measure did somewhat modify the bundles of care and the patient, provider, and medical care process variables that explained variation in resource use. However, in both analyses, at least two-thirds of the variation in resource use accounted for was the result of the same variables.

Similar analyses were also done for hemorrhoids, to compare the effect of use of dollars or RVS units to measure resource use in a condition in which a low proportion, 16 percent, of total RVS units were laboratory or radiology units. Figures 3-5 and 3-6 show the analyses for hemorrhoids. The variables in the analyses are listed in Table 3-3. With dollars as the resource use meaure, 17 percent of the variation was accounted for by laboratory and radiology procedures. Using RVS units, 29 percent of the variation was accounted for by laboratory or radiology procedures. However, for both resource use measures, the costliest episodes were those receiving two or more rubberband ligations. In both analyses, for those receiving none or one ligation, the next most important variable was two or more followup office visits for hemorrhoids. These variales accounted for approximately nine-tenths of the total explained variation in resource use in both analyses. Figures 3-7 and 3-8, showing resource use as predicted by the patient, provider, and medical care process variables used in Table 3-4, are identical for dollars

and for RVS units. For this condition, use of dollars or RVS units as a resource use measure made little difference in results of these analyses.

In summary, the dollar-based measures of resource use did generate somewhat modified bundles of care and patient, provider, and medical care process predictor variables than did RVS units. The difference arose because the total dollar measure accounted for the lower cost of producing laboratory and radiology RVS units. However, the differences were not large, even for hypertension, the disease in which the highest proportion of total RVS units were laboratory and radiology RVS units. Therefore, although dollar units were a more sensitive measure of resource use, RVS units also were a valid resource use measure.

Development of Analysis Protocols

1. Assumptions - The analysis of episodes of medical care required certain assumptions in interpreting the data. These assumptions included the following:

   a. Data system errors were random - Each individual contact with the medical care system involved the entry of several thousand potential responses in 210 data fields. Errors did occur. It was assumed that any errors in the data were not skewed in favor of any particular hypothesis, and that, given the large data set, errors would cancel each other out during analysis.

b. Summary measures represented the phenomenon of interest - e.g., an attempt to examine the effect of a routine follow-up visit on the total cost of an episode of illness may be confused by the fact that it is not possible to distinguish between care rendered for complications and follow-up care that is routine.

c. Available data permited stratification and adjustment of most potentially confounding variables including age and sex.

d. Whatever time period, such as three months, six months, etc., that is used to measure resource use, the number of persons leaving the program during that period was very small compared to the number remaining. Repeated examination of this question and comparison in selected cases with calendar file membership information confirmed that this was true.

e. Resource use for an office visit where the morbidity of interest was a secondary diagnosis was measured by examining episodes in relation to the number of coexisting morbidities. It was decided that the RVS units for an office visit should always be completely assigned to the presenting morbidity, the major reason for the visit. Thus, when an individual came in because of an active ulcer, for example, and also used the visit to have his high blood pressure medication refilled, the office visit was charged to the ulcer and not the hypertension. All other services rendered for hypertension, however, were still charged to that morbidity.

Therefore, no charge was made for office visits if the condition of interest was secondary to another morbidity; full charge was made where it was primary, regardless of the number of secondary diagnoses for which care may have been rendered. An attempt was made to deal with this problem by analyzing the relation between the presence and absence of other morbidities on RVS units charged to an episode of care.

2. Preparation of Data Files

A printout of all contacts in which a morbidity of interest appeared in the medical record system was obtained. This file consisted of a separate entry for every contact including office visits, laboratory and x-ray visits, letters, phone calls, emergency room visits, etc. Each entry included the information already discussed and indicated whether or not the morbidity of interest was the primary reason for the visit (as opposed to being secondary to other morbidities), and noted whether or not the morbidity of interest was confirmed (updated), either at that contact or at a subsequent one. Thus, it was possible to identify contacts made for a confirmed morbidity separate from those made for the same morbidity but in which that diagnosis was never confirmed. In most cases, only contacts of confirmed morbidity are used in these analyses.

These printouts were reviewed for accuracy and consistency and, in many cases, questionable data fields led to the review of medical records. The primary systematic error

identified was the inclusion of two or more episodes of a chronic disease (which by definition can only occur once in a given individual). These were corrected. Errors in data entry in discrete fields were not systematically corrected, but were corrected where noted.

The review of printouts was essential to the development of appropriate analysis requests, and they resulted in the submission of requests for episode summaries of each condition.

d. Episode summary file preparation

For each condition, frequency distribution statistics were obtained for the variables in the contact file. These distributions were reviewed and used to create episode summary files.

A critical issue in reducing the tens of thousands of data items available to a comprehensible set of episodes of medical care was the determination of how individual contacts were to be summarized into the episode. Each disease was summmarized according to criteria specific for the condition. Many critical decisions were made in creating the episode files. For example, how was age to be handled? For chronic conditions there was as much as a seven year difference in the age of an individual from his first to last contact. Which measure of age should be used: age at first contact, age at last contact, or mean age? How would the issue of program

eligibility be handled for the given condition? For chronic conditions what would be done about intermittent periods of membership? How would the length of the episode be determined? How would other patient and system characteristics be summarized?

For every variable a decision was made with respect to summarizing that variable into episodes of medical care, and definitions of utilization variables (e.g., total RVS units, total dollars, sub-categories of RVS use, numbers of office visits, numbers of hospitalizations, etc.) were specified. From these requests, summary records of total episodes of each given condition were created.

Another important determination made during this step concerned the groupings (termed "morbidity groups") to be used in the analysis. These groups were attempts to stratify the analysis by level of "severity" or morbidity type for a given condition. Thus, obese and non-obese hypertensives were examined separately in order to determine whether or not obesity influenced the treatment rendered. Each condition included two or more such morbidity groupings. In some cases whole classes of morbidities were discarded. For example, it was decided that persons with recurrent cystitis constituted a different population from those without a recent prior episode of the condition, and such cases were excluded.

Analysis of Episode Summary Files

A series of memos was written from experience with the first two conditions, to outline how to go about reviewing the

data and creating comprehensible and relatively uniform data sets and analysis requests. These memos are attached as Appendix II.

The analysis of episodes of care to: (1) identify alternative responses of the medical care system to the episodes; (2) account for differences in response through characteristics of the patient, provider, and medical care system and; (3) identify resource use implications, required a variety of statistical techniques. These are discussed in the general order from simplest to most complex. Generally, the analytic patterns proceeded in this order, although exceptions occurred for a number of conditions. Certain findings suggested the need to redefine variables, or that a technique not appropriate for one condition was appropriate for another.

Frequency Distributions - This technique was used to describe the utilization, patient, physician and medical system characteristics of episodes of each selected condition.

Crosstabulations - For episode files, the next step was the creation of crosstabulation tables, or joint frequency distributions of episodes by two or more variables. This also provided several tests of statistical significance including chi square and measures of association such as the contingency coefficient and gamma.

Breakdown - The SPSS breakdown subprogram was used to determine means, sums, standard deviations, and variances of dependent variables (measures of resource use) among subgroups

of episodes. Although there is some overlap in the type of information produced by crosstabulations and breakdown subprograms, the latter provided considerably more detail about subgroups of episodes and their influence on the dependent variable. Both were used to determine relationships between resource use during episodes and patient, physician and medical care system characteristics.

Correlation analysis (Pearson product-moment correlation coefficients, Spearman and Kendall rank-order correlation coefficients) - Correlations between pairs of variables were produced. Variables were limited to those for which there were reasons to suspect that correlations might occur, or might be important if they did occur. Selection of variables was empirical, and, in part, a result of the previous analyses. The correlation tables were used to identify variables with strong bivariate, linear relationships, and to determine areas where such a relationship was lacking. This permitted the inclusion of independent variables with strong relationships to utilization in the multivariate analyses. It also served to focus attention on those variables which had overlapping variance.

Multiple regression - Multiple regression permits an analysis of the linear relationship between a dependent variable and a set of predictor variables. It shows how well the predictors can be used to determine the level of the dependent variable. It tests only linear relationships or non-linear

relationships which have been adapted to the linear regression model (e.g., use age^2 instead of age as a predictor). It does not test for non-linear relationships of a form not suspected.

Three problems arise in the use of this technique: 1) the variables selected for an analysis may not be the best available predictors of the dependent variable; 2) the relationship between the predictor and dependent variables may not be linear; and 3) overlapping information which is explained by two or more predictors will be entirely ascribed to the first predictor to enter the regression equation, thus masking any relationship with the second predictor. For these reasons regression equations are limited in their ability to describe the nature of the interactions between two sets of variables.

Discriminant analysis - This technique was used sparingly in the analysis of episodes. Discriminant analysis is a technique used to distinguish between different groups of cases based on a set of descriptive characteristics of the groups. Instead of predicting the value of an outcome, discriminant analysis uses predictor variables to assign individuals to a limited set of groups. This technique also has a linear assumption.

Automatic Interaction Detection (AID) - This is a technique developed by Sonquist and Morgan at the University of Michigan Survey Research Center in 1963.[6] The basic idea is the sequential identification and segregation of subgroups one

at a time, nonsymmetrically, so as to select the set of subgroups which will reduce the error in predicting the dependent variable as much as possible relative to the number of groups"[6].

Essentially, the method consists of a step-wise application of a one-way analysis of variance which results in the partititoning of a group into a set of non-overlapping subgroups whose means explain more of the variation in the dependent variable than any other such set of subgroups.[7]

The algorithm of Sonquist and Morgan[8] for accomplishing this consists of the following four steps:

1. Beginning with the total sample, select that group, i, which has the largest total sum of squares.

2. Consider all possible binary splits of predictors on the dependent variable and select the optimal split of that predictor which provides the largest reduction in the unexplained sum of squares. Groupings of the predictors may be forced into descending sequence, or may be permitted to take on a non-linear arrangement as required. Split the

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[6] Sonquist JA, Morgan JN. J Amer Stat Assoc 1963; 58:415-435.

[7] Sonquist JA. Multivariate model building. The validation of a research strategy. Ann Arbor: Institute for Social Research, 1970.

[8] Sonquist JA, Morgan JN. The detection of interaction effects. Monograph No. 35, Survey Research Center, Ann Arbor: Institute for Social Research, University of Michigan, 1964.

dependent variable into two groups by optimally dichotomizing the best predictor variable.

3. For a partition of the dependent variable to take place, the between group sum of squares associated with this partition must be larger than an arbitrary constant Q, and the total sum of squares for the group must be larger than an arbitrary constant P. If one or both of these conditions is not met, the group cannot be split.

4. If there are no more unsplit groups that can meet the above requirements or if the number of unsplit groups exceeds some arbitrary integer, the process terminates.

The technique permits the construction of a decision tree with dichotomous splits in the parent group that account for all explainable variation in the dependent variable. Advantages include the fact that there is no linear assumption in the nature of the relationships, and the effects of a predictor on specific subgroups are readily identifiable. In addition, the data produced by the process are conceptually very easy to interpret.

Predictor variables may be dichotomous, categorical or continuous. The dependent variables must be continuous. Interpretation of the AID charts is explained in Figure 3-9.

Log-Linear Model for Multiway Contingency Tables - This technique is contained as a subprogram of the Biomedical Computer Programs (BMDP), P-Series.[9] The procedure allows

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[9] Dixon WJ, Brown MC, eds. BMDP-79. Biomedical Computer Programs, P-Series. Berkeley: University of California Press, 1979.

the testing of all significant interactions between a set of variables and the construction of a model which describes the interactions. In the log-linear model, hypotheses are specified by models which are fitted to cell frequencies that have been broken down into several multiplicative components. The frequencies are made linear by taking their logarithm, and this linearity is applied to a factorial arrangement of log frequencies.[10] Thus, the method is analagous to analysis of variance.

The parameters of the model can be interpreted in terms of the odds that a given episode falls into one or another category of resource use depending on the levels of the other variables. This is especially suited to combining with the AID analysis since that technique identified a series of treatment patterns or bundles associated with different levels of resource use. By analyzing these alternative bundles as choices of a single "bundle of care" variable, it is possible to determine how the selection of bundles is influenced by the patient, physician and medical care variables and also to determine the odds that a given episode will fall into a given bundle based on the values of the patient, provider, and medical care system variables present.

An especially important outcome of this technique is the ability to create an interaction model, that is, to identify the nature and degree of interactions between variables,

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[10] Payne C. The log-linear model for contingency tables. In: O'Muircheartaigh CA, Payne C, eds. The Analysis of Survey Data, Volume 2. Model Fitting. London: John Wiley & Sons, 1977.

whereas other multivariate procedures may mask a significant predictor because of overlapping variation.

The multivariate techniques were generally employed in the following manner. The AID analysis identified alternative responses in terms of diagnostic and treatment procedures for episodes of the selected conditions. The AID and/or the log linear multiway contingency analysis attempted to account for the variation in responses from the patient, provider and medical care system characteristics that were available. The AID analysis also provided estimates of the number of episodes in each treatment bundle, and of the mean and the variation from the mean resource use per episode in each treatment bundle. There were however, instances where these specific analytic steps differed for certain conditions. Where any variation occurs, it is described in the report for that condition.

TABLE 3-1

VARIABLES INCLUDED IN AID ANALYSIS OF SUBCOMPONENTS OF TOTAL UTILIZATION OF CARE, FOR ALL 465 HYPERTENSION EPISODES

1. Hospitalization (0, 1, 2-6)
2. Emergency room contacts (0, 1-3)
3. Telephone or letter contacts (0, 1, 2, 3, 4, 5-21)
4. Drug-related telephone calls (0, 1, 2, 3, 4-10)
5. Glucose tests (0, 1-2)
6. Uric acid tests (0, 1-8)
7. VMA-catecholamine tests (0, 1-2)
8. Urinalyses (0, 1-4)
9. EKGs (0, 1, 2-4)
10. Chest x-rays (0, 1-4)
11. Intravenous urographies (0, 1-22)
12. Complete blood counts (0, 1-2)
13. Creatinine/BUN tests (), 1, 2, 3-7)
14. Physical exams with hypertension as the presenting morbidity
15. Initial office visits for hypertension (0, 1)
16. House, nursing home, other miscellaneous contact types (0, 1-29)
17. Follow-up office visits per year for hypertension (0, .01-49, .50 - .99, 1.00-1.49, 1.50-1.99, 1.00-2.99, 3.00-3.99, 4.00-4.99, 5.00-5.99, 6-20)
18. Electrolyte tests (0, 1, 2, 3, 4, 5-20)
19. Phosphorus tests (0, 1-2)
20. Potassium tests (0, 1, 2, 3, 4, 5-17)
21. Sodium tests (0, 1, 2, 3-10)
22. Physical exams per year; hypertesion as presenting or associated morbidity (0, .01-.49, .50-.99, 1.00-1.49, 1.50-3.8)

TABLE 3-2

VARIABLES INCLUDED IN PATIENT/PROVIDER/MEDICAL CARE PROCESS AID ANALYSIS FOR ALL HYPERTENSION EPISODES

1. Consultant physician seen in episode? (y/n)
2. Is obesity a comorbidity at any contact? (y/n)
3. Is heart disease a comorbidity at any contact? (y/n)
4. Are drug adverse effects a comorbidity at any episode? (y/n)
5. Is the patient free of comorbidities related to hypertension? (y/n)
6. Comorbidity group of patient (heart, vascular, or cerebrovascular disease; diabetes without above; obesity without above; renal disease; oral contraceptive use; pregnancy without above; none of above)
7. Are any contacts with a non-physician provider? (y/n)
8. Are any contacts with a non-internist physician? (y/n)
9. Are any walk-in contacts present ? (y/n)
10. Is the diagnosis tentative or unknown in any contact? (y/n)
11. Are any contacts outside of normal medical office hours? (y/n)
12. Proportion of total contacts that are physical exams (0%, 1-25%, 26-50%, 50-100%)
13. Is the patient ineligible for Health Plan coverage at any contact? (y/n)
14. Year of index contact. (1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973)
15. Sex
16. Age at index contact (18-34, 35-49, 50-64, 65-74, 75+)
17. New vs. continuing episode
18. Are symptoms present at index contact? (y/n)
19. Is the patient eligible for Health Plan coverage during the full calendar year that includes the index contact? (y/n)
20. Physician status at index contact (regular attending, temporary attending, consultant)
21. Subscriber unit size at index contact (1, 2, 3, 4, 5-13)
22. Is a physical examination present within the episode?

TABLE 3-3

VARIABLES INCLUDED IN UTILIZATION AID ANALYSIS, FOR ALL 474 HEMORRHOID EPISODES

1. Hospitalizations (0, 1-2)
2. Emergency room visits (0, 1-3)
3. Telephone and letter contacts (0, 1, 2-4)
4. Medical office contacts, with hemorrhoids as presenting or associated morbidity (0, 1, 2, 3, 4, 5, 6, 7-16)
5. Number of physical examinations with hemorrhoids as presenting or as associated morbidity (0, 1, 2-4)
6. Number of emergency room or walk-in contacts (0, 1, 2-5)
7. Barium enemas (0, 1-2)
8. Number of laboratory tests in episode (0, 1-8)
9. Drug-related telephone calls (0, 1-2)
10. Number of diagnostic proctosigmoidoscopies (0, 1-2)
11. Number of anoscopies (0, 1-2)
12. Number of external hemorrhoid surgical procedures (0, 1-2)
13. Number of complete hemorrhoidectomies or any other external hemorrhoid operations (0, 1-2)
14. Number of rubber band ligations of hemorrhoids (0, 1, 2, 3-12)
15. Any internal or external hemorrhoid surgery (excluding ligation) done in the episode (y/n)
16. Number of initial office visits, with hemorrhoids as presenting morbidity (0, 1-3)
17. Number of follow-up office visits, with hemorrhoids as the presenting morbidity (0, 1, 2, 3, 4, 5-14)
18. Was the index contact an initial office visit with hemorrhoids as the presenting morbidity (y/n)
19. Was the index contact a follow-up office visit with hemorrhoids as the presenting morbidity (y/n)

20. Was anoscopy or proctosigmoidoscopy done at the index contact (y/n)

21. Was rubber band ligation done at the index contact (y/n)

22. Was internal or external hemorrhoid surgery (other than ligation) done at the index contact? (y/n)

23. Was a barium enema cone at the index contact? (y/n)

24. Place of index contact (medical office, emergency room, letter, telephone, inpatient)

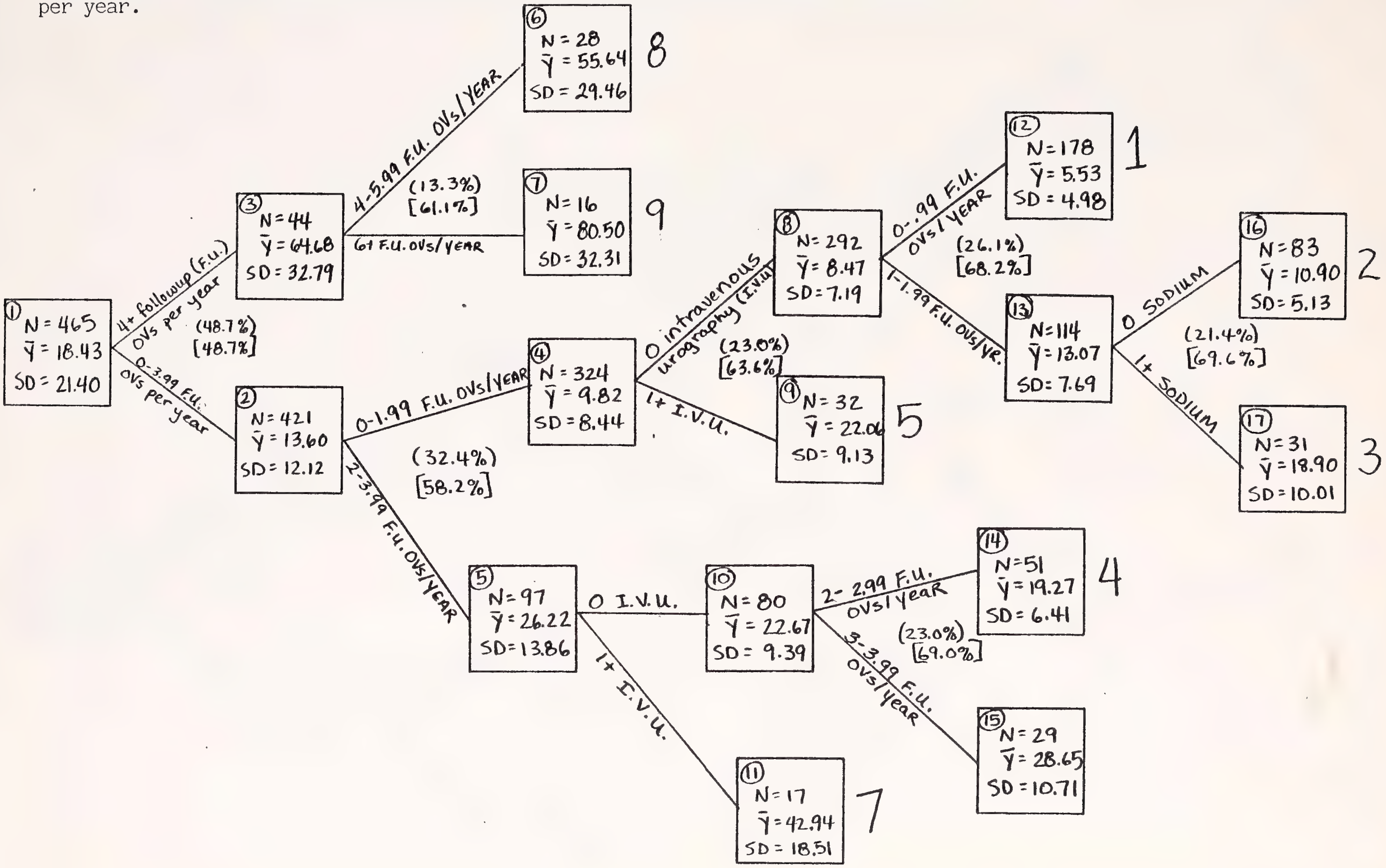
TABLE 3-4

VARIABLES INCLUDED IN PATIENT/PROVIDER/MEDICAL CARE PROCESS AID ANALYSIS FOR ALL 474 HEMORRHOID EPISODES

1. Proportion of all contacts that are regularly scheduled medical office visits (0%, 1-100%)
2. Proportion of contacts that are walk-in office visits (0%, 1-100%)
3. Are any contacts outside of regular office hours? (yes, no)
4. Comorbidities over episode (anal-rectal disease, pregnancy, neither)
5. Hemorrhoid symptoms present over episode (internal hemorrhoid symptoms and external hemorrhoid symptoms; external hemorrhoid symptoms only; internal hemorrhoid symptoms only; no hemorrhoid symptoms)
6. Proportion of contacts in which hemorrhoids is the presenting morbidity (0%,1-99%, 100%)
7. Proportion of contacts which are phsycial examinations (0%, 1-100%)
8. Is an internist visited in the episode? (no, yes)
9. Is a surgeon visited in the episode? (no, yes)
10. Are there any contacts in the episode in which the diagnosis is either 'unknown' or 'tentative'? (no, yes)
11. Are any symptoms noted in the episode? (no, yes)
12. Physician status over episode (consultant seen, only reg. attend. M.D. seen, only temp. attend. M.D. seen; temp. attend. and reg. attend. M.D. seen, without consult.)
13. Sex (male, female)
14. Patient age at index contact (18-39, 40-59, 60+)
15. Is the patient eligible for Health Plan coverage during the entire year of the index contact? (no, yes)
16. Patient subscriber unit size at index contact (1,2,3,4,5-12)
17. Morbidity status at index conatct (presenting, 1st assoc. morbidity, 2nd associated morbidity, 3rd- 8th associated morbidity)
18. Physician status at index contact (regular attending, temporary attending, consultant)
19. Is this a new episode? (no, yes)
20. Is the index contact presenting diagnosis hemorrhoids? (no, yes)
21. Return order at index contact? (no, yes)
22. Symptoms at index conatct (no symptoms, symptoms of internal hemorrhoids only, symptoms of external hemorrhoids only, gastrointestinal symptoms--primarily melena)
23. Is the index contact outside regular medical office hours? (no, yes)
24. Type of index contact appointment (regularly scheduled medical office visit, walk-in, hospital emergency room, telephone or letter, inpatient)
25. Status of diagnosis at index contact (established, tentative, unknown)
26. Physician specialty at index contact (internist, surgeon, obstetrician/gynecologist, other specialties)
27. Index contact comorbidities (anal-rectal disease, pregnancy, neither)
28. Year of index contact (1966-1973)

FIGURE 1

A I D analysis for all 465 hypertension episodes; individual all-episode utilization measures are used to predict total dollar cost per episode year. Boxes contain number of cases (N), mean dollars per year (Y), and standard deviation (S.D.) for episodes in each group. Parentheses contain percent of variation in parent group explained by each split. Brackets contain cumulative variation in entire population explained by all prior splits. Large numbers indicate terminations of bundle pathways in order of increasing mean dollar costs per year.



① N = 465 $\bar{Y}$ = 18.43 SD = 21.40
4+ followup (F.U.) OVs per year
0-3.99 F.U. OVs per year
(48.7%) [48.7%]
③ N = 44 $\bar{Y}$ = 64.68 SD = 32.79
② N = 421 $\bar{Y}$ = 13.60 SD = 12.12
4-5.99 F.U. OVs/YEAR
6+ F.U. OVs/YEAR
(13.3%) [61.1%]
⑥ N = 28 $\bar{Y}$ = 55.64 SD = 29.46
8
⑦ N = 16 $\bar{Y}$ = 80.50 SD = 32.31
9
0-1.99 F.U. OVs/YEAR
2-3.99 F.U. OVs/YEAR
(32.4%) [58.2%]
④ N = 324 $\bar{Y}$ = 9.82 SD = 8.44
⑤ N = 97 $\bar{Y}$ = 26.22 SD = 13.86
0 intravenous urography (I.V.U.)
1+ I.V.U.
(23.0%) [63.6%]
⑧ N = 292 $\bar{Y}$ = 8.47 SD = 7.19
⑨ N = 32 $\bar{Y}$ = 22.06 SD = 9.13
5
0-.99 F.U. OVs/YEAR
1-1.99 F.U. OVs/YR.
(26.1%) [68.2%]
⑫ N = 178 $\bar{Y}$ = 5.53 SD = 4.98
1
⑬ N = 114 $\bar{Y}$ = 13.07 SD = 7.69
0 SODIUM
1+ SODIUM
(21.4%) [69.6%]
⑯ N = 83 $\bar{Y}$ = 10.90 SD = 5.13
2
⑰ N = 31 $\bar{Y}$ = 18.90 SD = 10.01
3
0 I.V.U.
1+ I.V.U.
⑩ N = 80 $\bar{Y}$ = 22.67 SD = 9.39
⑪ N = 17 $\bar{Y}$ = 42.94 SD = 18.51
7
2-2.99 F.U. OVs/YEAR
3-3.99 F.U. OVs/YEAR
(23.0%) [69.0%]
⑭ N = 51 $\bar{Y}$ = 19.27 SD = 6.41
4
⑮ N = 29 $\bar{Y}$ = 28.65 SD = 10.71

FIGURE 3-2

A I D analysis for all 465 hypertension episodes; individual all-episode utilization measures are used to predict total RVS per episode year. For explanation of symbols used, see Figure 3-1.

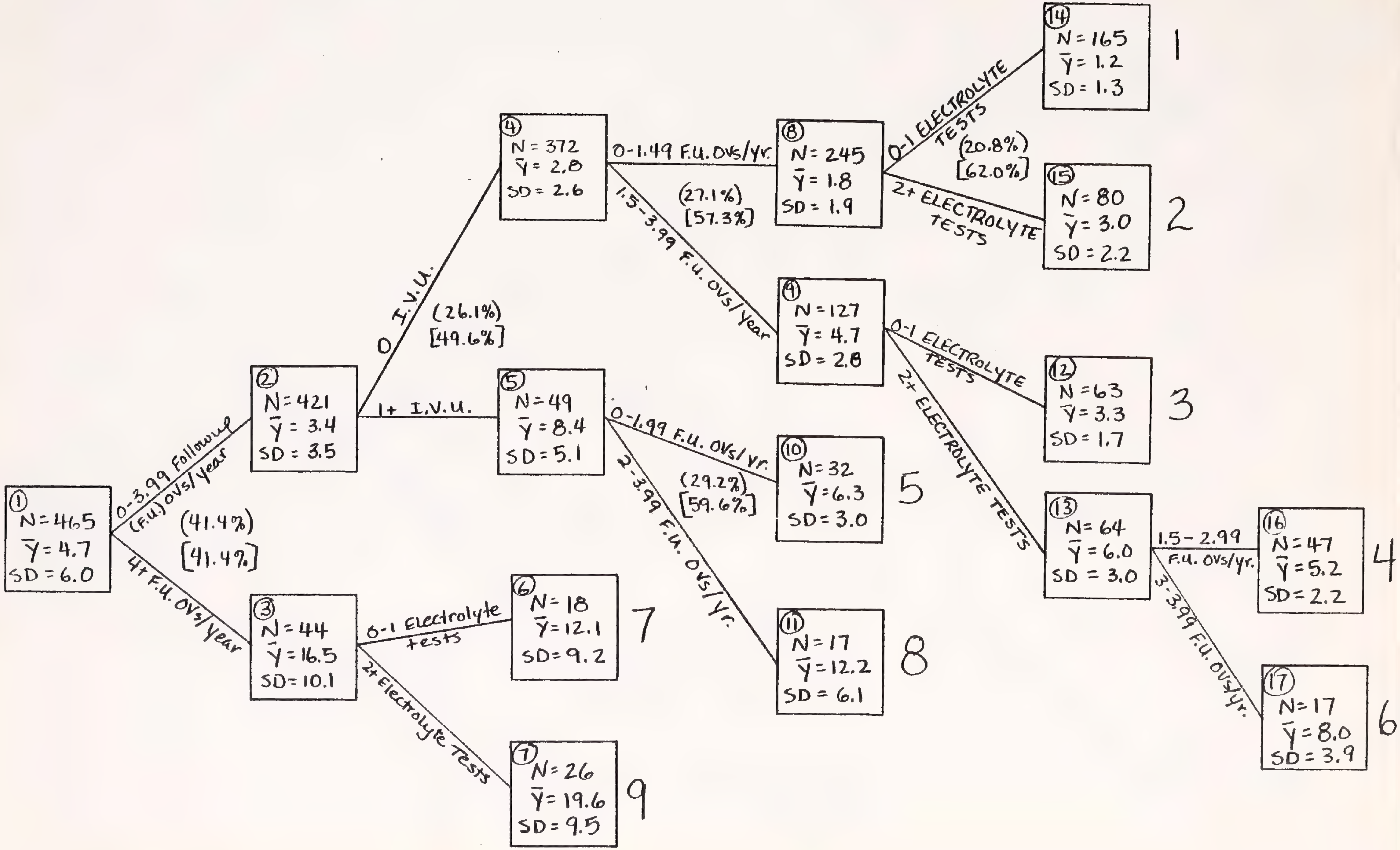


FIGURE 3-3

A I D analysis for all 465 hypertension episodes; patient, medical care process, and provider characteristics are used to predict total dollar cost per episode year. For explanation of symbols, see Figure 3-1.

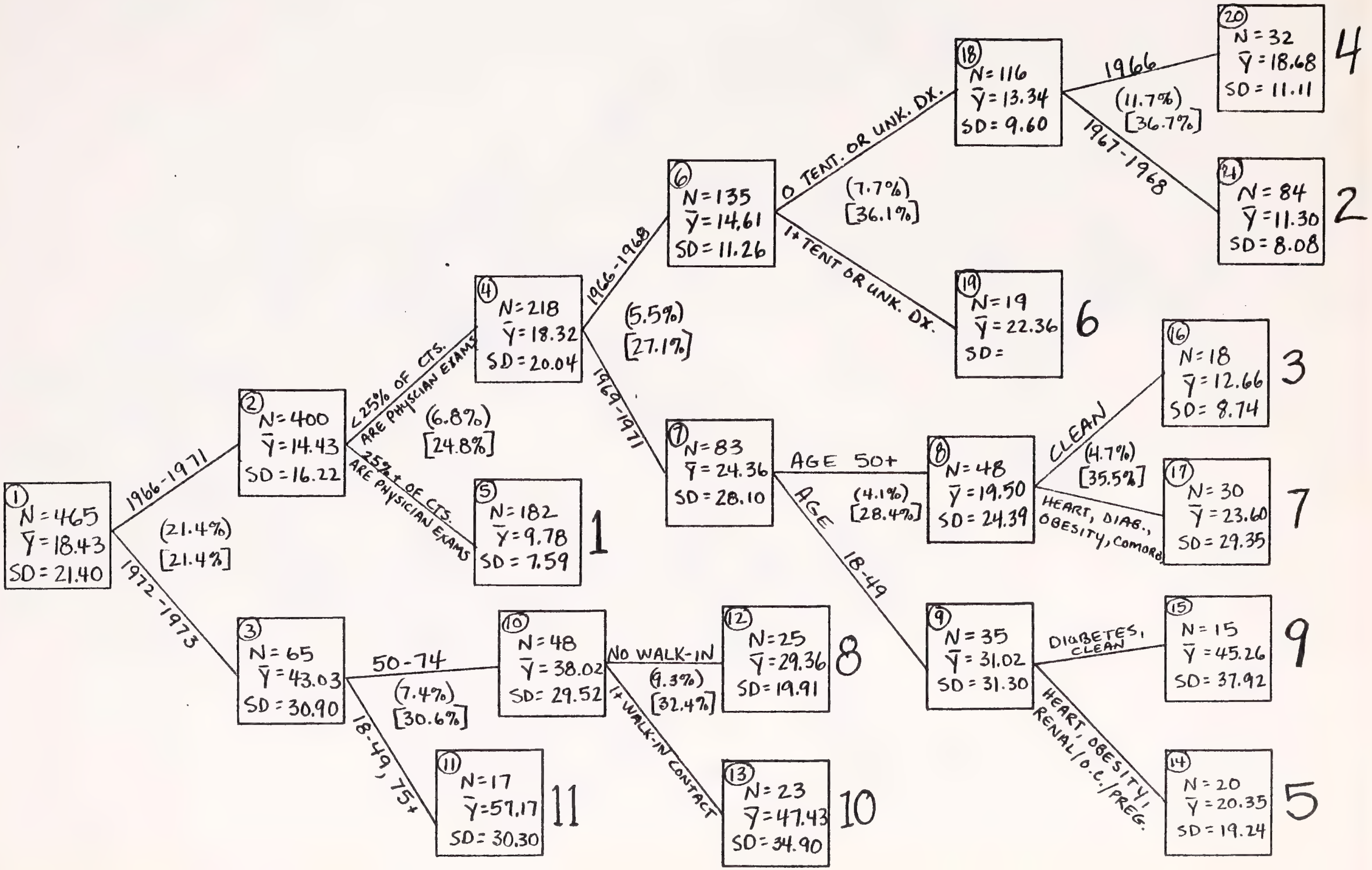

① N=465 $\bar{Y}$=18.43 SD=21.40
1966-1971
(21.4%) [21.4%]
1972-1973
② N=400 $\bar{Y}$=14.43 SD=16.22
<25% OF CTS. ARE PHYSICIAN EXAMS
(6.8%) [24.8%]
25%+ OF CTS. ARE PHYSICIAN EXAMS
③ N=65 $\bar{Y}$=43.03 SD=30.90
50-74
(7.4%) [30.6%]
18-49, 75+
④ N=218 $\bar{Y}$=18.32 SD=20.04
1966-1968
(5.5%) [27.1%]
1969-1971
⑤ N=182 $\bar{Y}$=9.78 SD=7.59
1
⑥ N=135 $\bar{Y}$=14.61 SD=11.26
0 TENT. OR UNK. DX.
(7.7%) [36.1%]
1+ TENT OR UNK. DX.
⑦ N=83 $\bar{Y}$=24.36 SD=28.10
AGE 50+
(4.1%) [28.4%]
AGE 18-49
⑧ N=48 $\bar{Y}$=19.50 SD=24.39
CLEAN
(4.7%) [35.5%]
HEART, DIAB., OBESITY, COMORB.
⑨ N=35 $\bar{Y}$=31.02 SD=31.30
DIABETES, CLEAN
HEART, OBESITY, RENAL/O.C./PREG.
⑩ N=48 $\bar{Y}$=38.02 SD=29.52
NO WALK-IN
(9.3%) [32.4%]
1+ WALK-IN CONTACT
⑪ N=17 $\bar{Y}$=57.17 SD=30.30
11
⑫ N=25 $\bar{Y}$=29.36 SD=19.91
8
⑬ N=23 $\bar{Y}$=47.43 SD=34.90
10
⑭ N=20 $\bar{Y}$=20.35 SD=19.24
5
⑮ N=15 $\bar{Y}$=45.26 SD=37.92
9
⑯ N=18 $\bar{Y}$=12.66 SD=8.74
3
⑰ N=30 $\bar{Y}$=23.60 SD=29.35
7
⑱ N=116 $\bar{Y}$=13.34 SD=9.60
1966
(11.7%) [36.7%]
1967-1968
⑲ N=19 $\bar{Y}$=22.36 SD=
6
⑳ N=32 $\bar{Y}$=18.68 SD=11.11
4
(21) N=84 $\bar{Y}$=11.30 SD=8.08
2

Figure 3-4
AID analysis for all 465 hypertension episodes; patient, medical care process, and provider characteristics are used to predict total RVS per episode year.

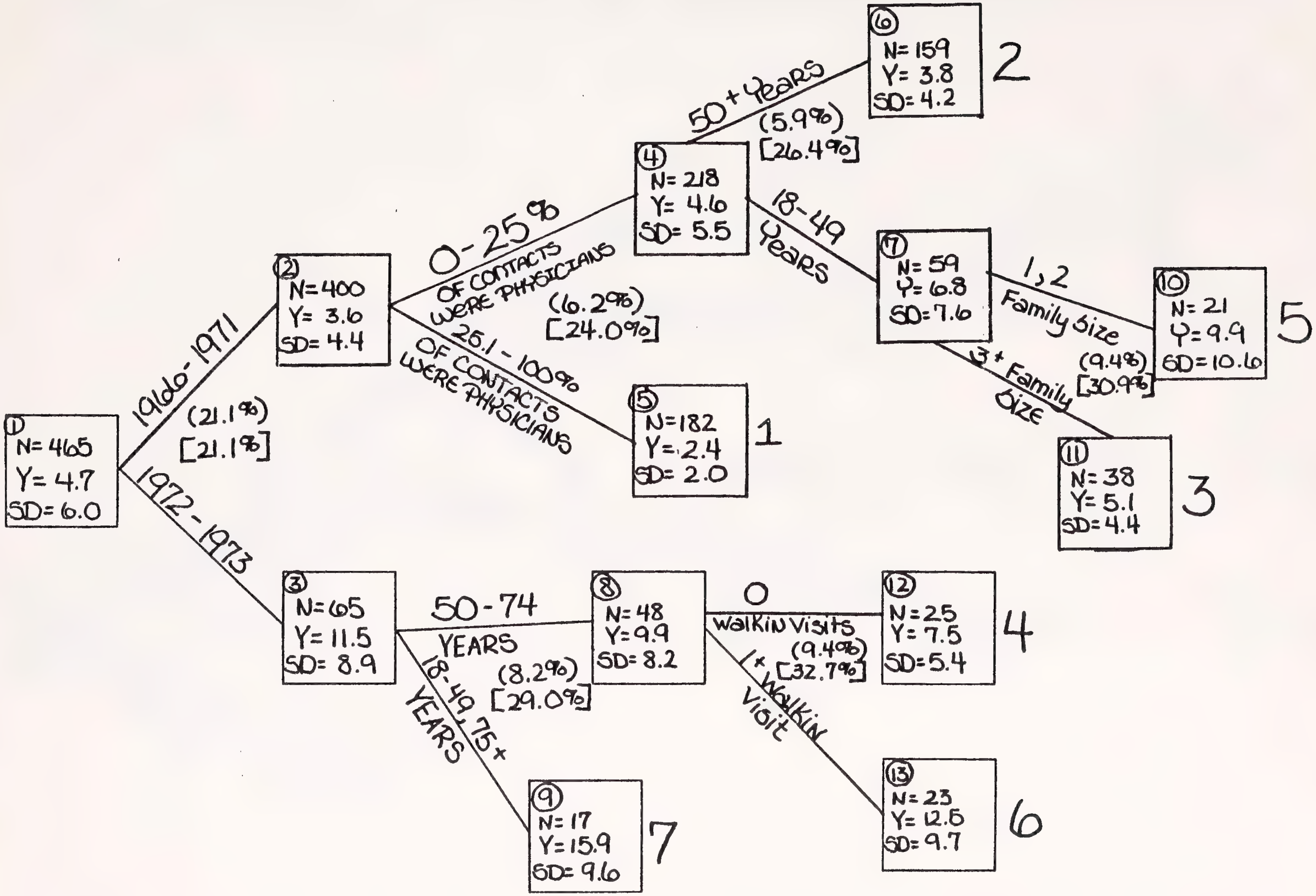
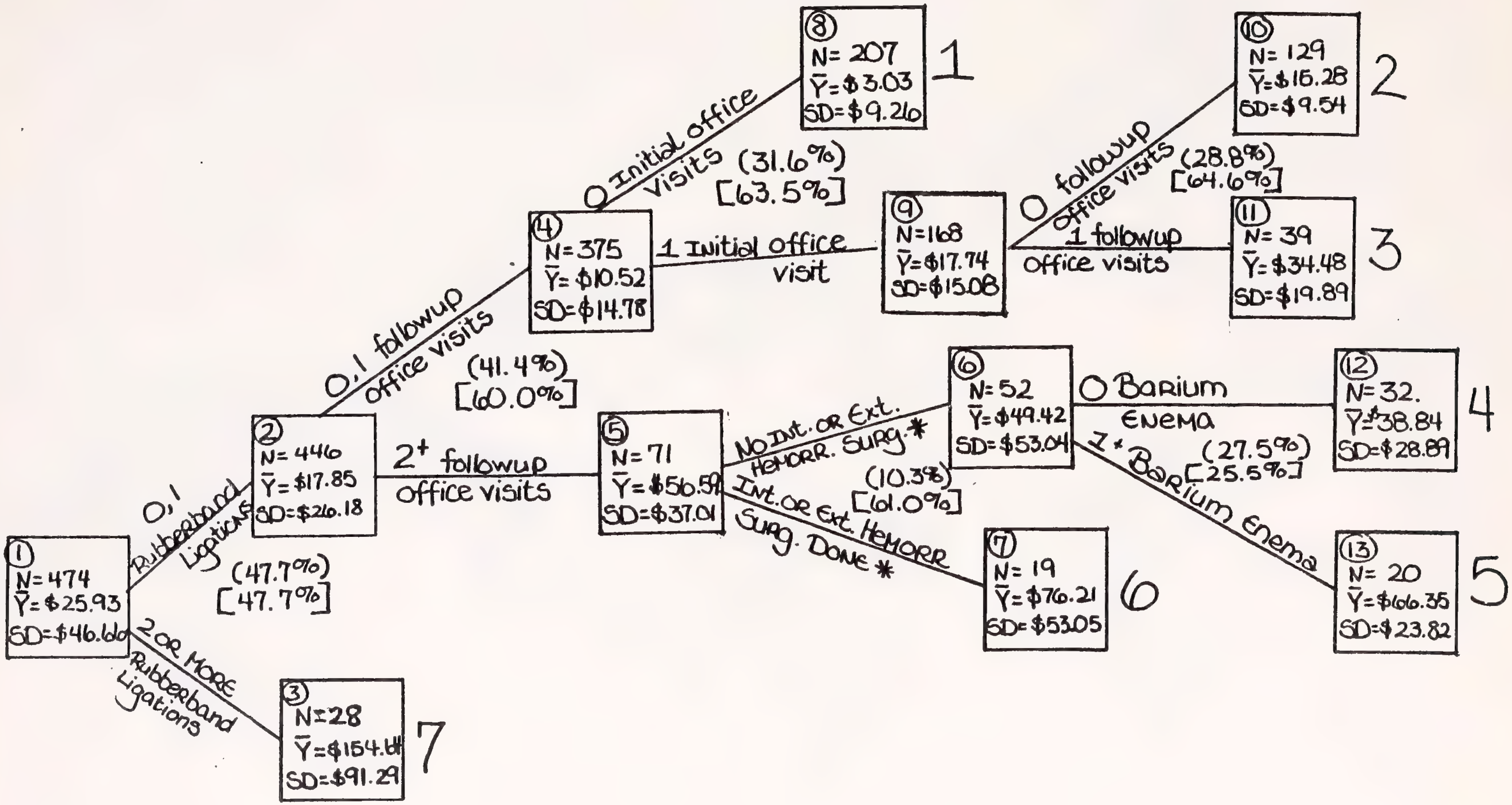


Figure 3-5
AID analysis for all 474 episodes of hemorrhoids; individual all-episode utilization measures are used to predict total episode dollar cost. Boxes contain number of cases (N), mean dollars per episode ($\bar{Y}$), and standard deviation (SD) for episodes in each group. Parentheses contain percent of variation in parent group explained by each split. Brackets contain cumulative proportion of variation in cost for entire population explained by all prior splits. Large numbers indicate terminations of bundle pathways in order of increasing mean dollar costs.



*This is a separate set of procedures from rubberband ligation.

Figure 3-6
AID analysis for all 474 hemorrhoid episodes; individual all-episode utilization measures are used to predict total RVS. For explanation of symbols, see Figure 3-5.

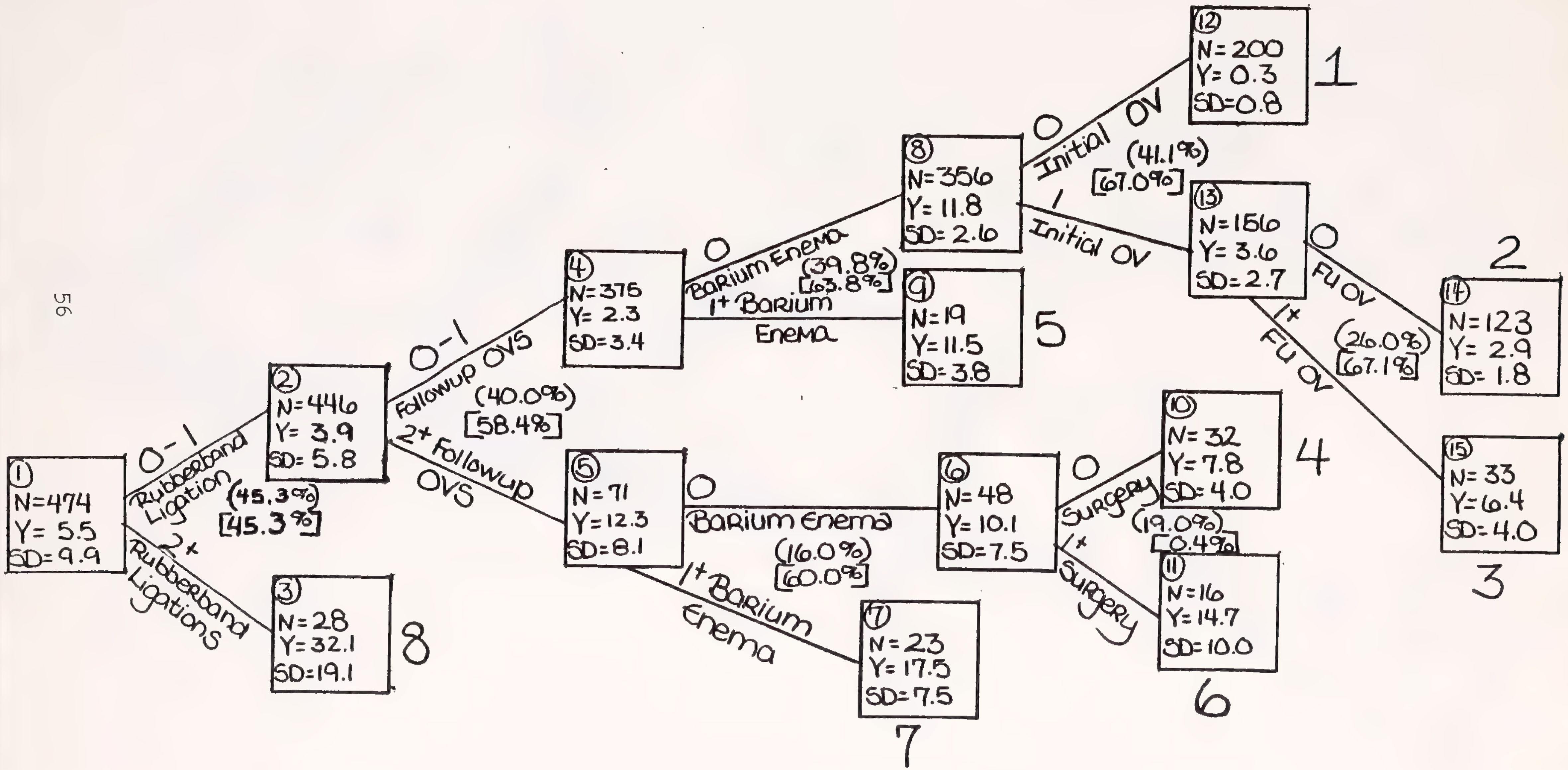


Figure 3-7
AID analysis for all 474 hemorrhoid episodes; patient, medical care process, and provider characteristics are used to predict total episode dollar cost. For explanation of symbols, see Figure 3-5.

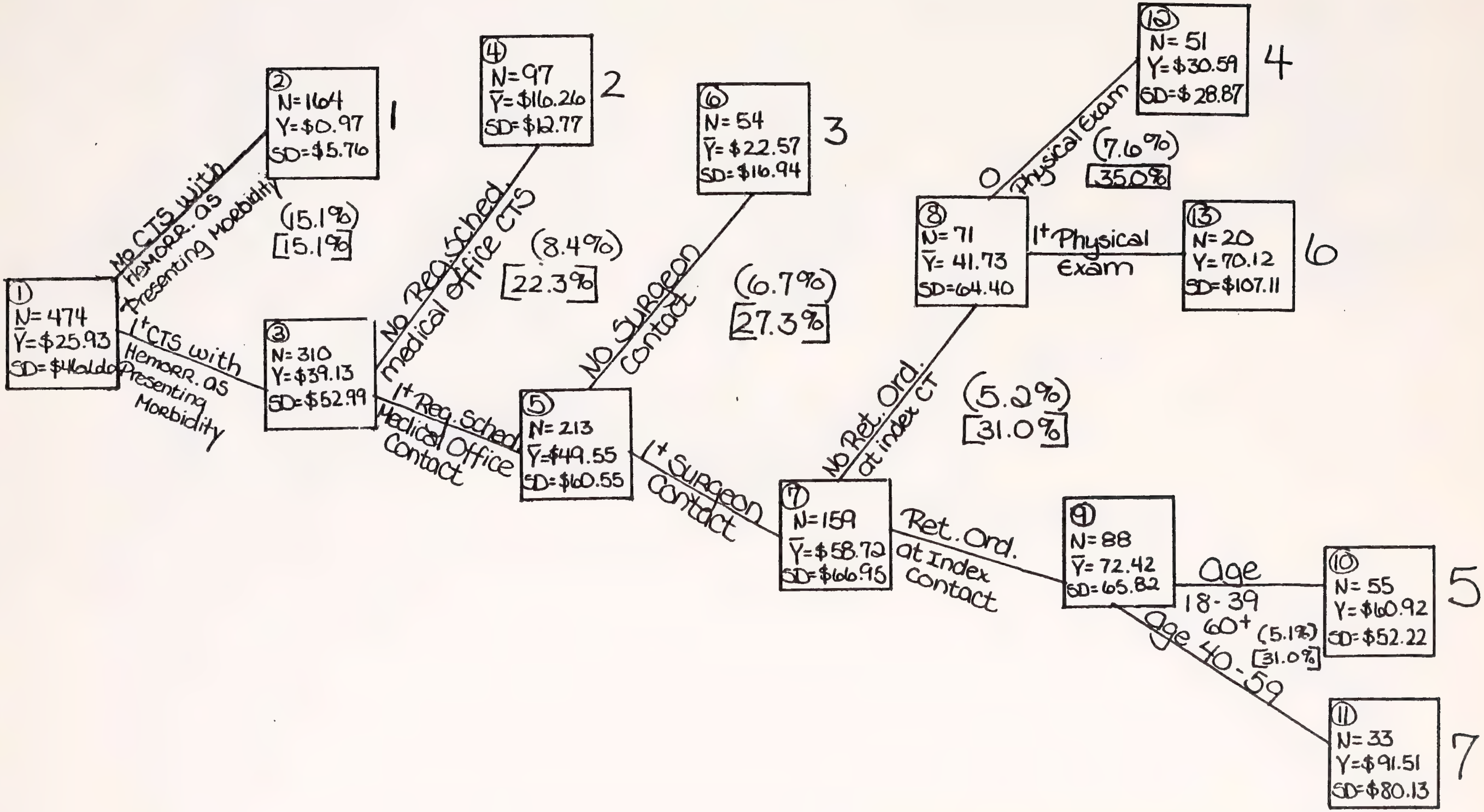

① N=474 Ȳ=$25.93 SD=$41.60
No CTS with Hemorr. as Presenting Morbidity
1+ CTS with Hemorr. as Presenting Morbidity
(15.1%) [15.1%]
② N=164 Y=$0.97 SD=$5.76
1
③ N=310 Y=$39.13 SD=$52.99
No Reg. Sched. medical office CTS
1+ Reg. Sched. Medical Office Contact
(8.4%) [22.3%]
④ N=97 Ȳ=$16.26 SD=$12.77
2
⑤ N=213 Ȳ=$49.55 SD=$60.55
No Surgeon Contact
1+ Surgeon Contact
(6.7%) [27.3%]
⑥ N=54 Ȳ=$22.57 SD=$16.94
3
⑦ N=159 Ȳ=$58.72 SD=$66.95
No Ret. Ord. at index CT
Ret. Ord. at Index Contact
(5.2%) [31.0%]
⑧ N=71 Ȳ=41.73 SD=64.40
0 Physical Exam
1+ Physical Exam
(7.6%) [35.0%]
⑫ N=51 Y=$30.59 SD=$28.87
4
⑬ N=20 Y=70.12 SD=$107.11
6
⑨ N=88 Ȳ=72.42 SD=65.82
Age 18-39 60+
Age 40-59
(5.1%) [31.0%]
⑩ N=55 Y=$60.92 SD=$52.22
5
⑪ N=33 Y=$91.51 SD=$80.13
7

Figure 3-8
AID analysis for all 474 hemorrhoid episodes; patient, medical care process, and provider characteristics are used to predict total episode RVS. For explanation of symbols, see Figure 3-5.

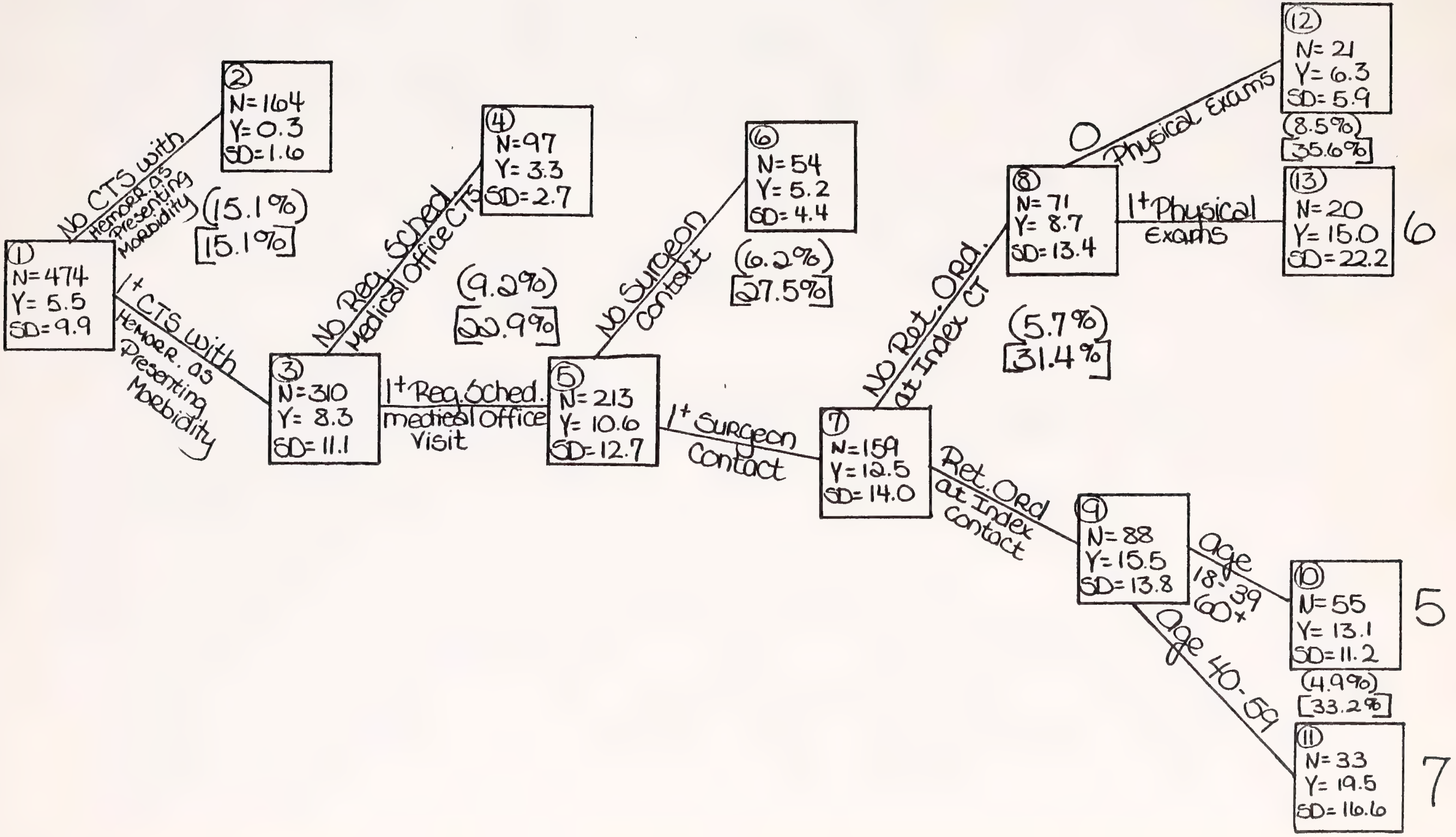
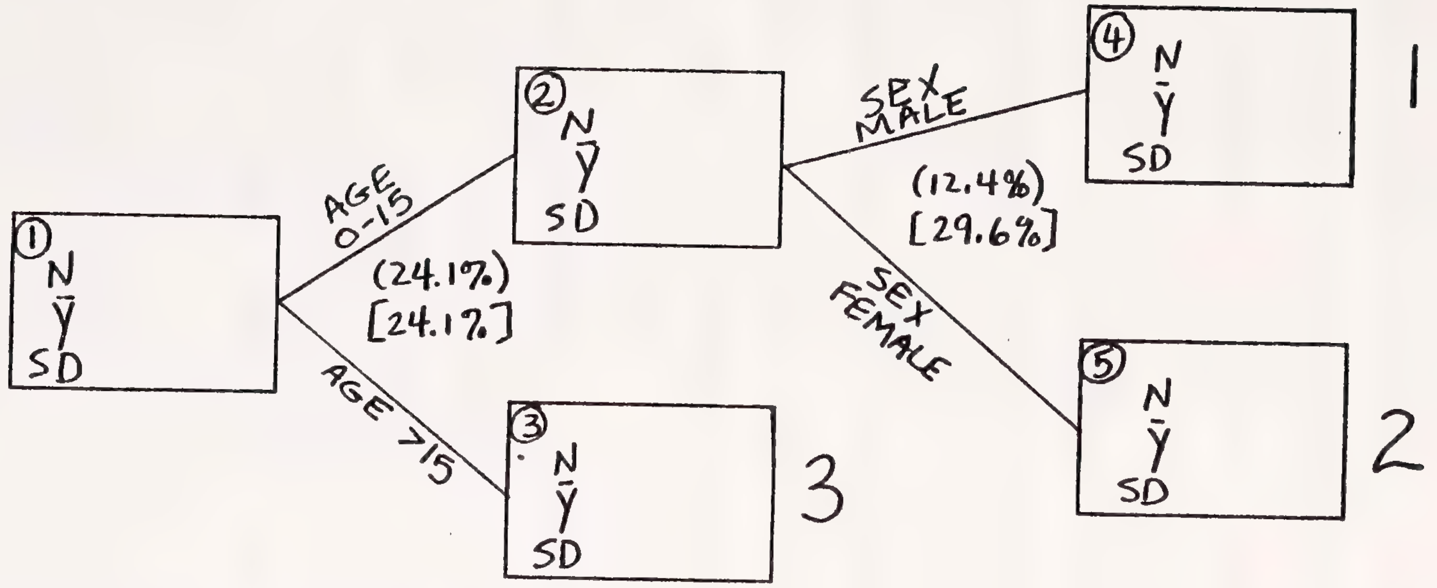


FIGURE 3-9

Interpretation of AID Charts



A I D analysis begins with a parent group, selects the predictor variable that explains more of the variation in that group than any of the other predictors, selects the optimal means for dichotomizing that predictor, then splits the parent group into two subgroups using the predictor. It then applies all predictors to each subgroup and continues the process until all significant variation explained by the predictors has been accounted for.

Symbols = circled numbers (①, ②,...) refer to the group contained in each box.
N = number of individuals in each box.
Y = average of outcome variables (e.g., RVS units) for each box.
SD = standard deviation of the average in each box.

Large numbers (1,2,3) represent terminal boxes for complete bundles. That is, bundle one, above, consists of persons age 0-15 who are male. Between each split are two numbers. The top number represents the amount of variation in the group being split which is explained by the split. The bottom number, in brackets, is the amount of variation in the original parent group, group ①, which is explained by this and all preceding splits taken together. The contribution of any given split to variation in the original parent group can be found by subtracting the number in brackets from the preceding split, from the number in brackets for the current split. Thus, in the above example, the split into male and female groups explains 12.4 percent of the variation in RVS units for persons 0-15, and 29.6 - 24.1 = 5.5 percent of variation of RVS units in group ①. The combination of splits by age and by sex explains 29.6 percent of variation in group ①.

SECTION IV. ASSETS AND LIMITATIONS OF THE DATA

General Intent

The primary data system for this study was developed to study medical care utilization.

The data consist of information abstracted from the outpatient medical record. It should be recognized that no formal procedures exist to effect a specific approach to the recording of information by providers at the time of medical care treatment. This was a conscious decision at the time data collection was initiated to assure that the "laboratory" for the study of medical care utilization was not disrupted and continued to exist in its "natural state." That is, within the KPMCP which is the laboratory, the behavior of the providers would not in any way be affected by the research process. There are, however, data system procedures to collect certain information, subsequent to treatment and unobtrusively, if such data are not available from the medical record. These data include the reason for the visit and any procedures rendered during the visit.

This approach assures a high probability of completeness for data fields necessary for the study of medical care utilization. Once completed, each data field is also subjected to routine editing procedures. On the other hand, there are several data fields that do not contain complete information. The validity of these data however, was not critical to the study. These data fields are identified subsequently.

The Outpatient Information System, while providing a comprehensive set of utilization data, does not contain data about morbidities diagnosed prior to the date of the initiation of the data system or about morbidities treated outside the KPMCP. Information available from surveys conducted among Health Plan members indicates that use of services outside the KPMCP is infrequent, and when it occurs, the use of services is not generally extensive.

Disease Data

Morbidity data, which are descriptions of the conditions affecting persons at the time of their contacts, are obtained from physicians' and other providers' written entries into the outpatient medical record. Data system procedures require that when persons who are part of the outpatient information system contact the KPMCP, whether by telephone, letter, or personal appearance, the reason for the contact is identified, recorded, and coded.

The data system procedures provide for coding the morbidities with the 7th edition, ICD Adapted, codes. These codes have been supplemented to include symptomatic illnesses and new diseases that are not included in the 7th edition. The continuing use of this revision allows for the consistent identification of morbidities over time and facilitates the episodic approach to the disease process. However, while a specific code may be consistent in indicating the presence of the condition as interpreted from physician notes, most codes

provide no information as to the severity of the morbidity or to the stage of the disease process.

The supplemental codes provide for the identification of the major symptoms at the time of the first contact for a morbidity but only if the providers record any symptoms in the medical record. This particular field of data need not contain any information. As a result, the absence of information in this field does not necessarily mean that no symptoms were reported at the time of the contact.

As previously indicated, the morbidities abstracted from the medical record and maintained in the data system derive from information that physicians or other providers of care enter in the medical record. The morbidities diagnosed during the contact are the providers' interpretations of the clinical signs or symptoms and other information available to them at that time. Thus, the morbidities identified may not always fit a medical textbook's clinical definition of the morbidity. In addition, subsequent information that individual providers obtain from return visits or the results of laboratory tests and the like, may or may not lead to changing (updating) the original diagnosis.

The coding procedures whereby the specific morbidities can be linked together to generate an episode of care made this study possible. While this linkage is the most sophisticated aspect of the data, it is also vulnerable to variable interpretations of the relationship of morbidities that occur

simultaneously at a contact and that occur over time. Judgments must be made by the medical record abstractors as to whether a morbidity identified at a contact is or is not related to a morbidity that may have occurred at a prior contact, and if multiple morbidities are identified at a contact, whether or not these morbidities are related or coincidental to each other.

When the morbidity is determined to be related to a morbidity that occurred at a prior contact and if the morbidities are identical, the morbidity at the subsequent contact can become a continuation of the original morbidity or part of an episode of the original presenting morbidity. If the morbidities were determined to be related but the subsequent morbidity is not the same as the original morbidity, a decision must be made as to whether the subsequent morbidity should replace (update) the original morbidity or should be a separate but related morbidity to the original morbidity.

Each of these decisions is guided by a variety of techniques in the coding process whereby such assignments are made. However, due to the complexities of judgments required and of the techniques to facilitate the judgments, the episodes for each study morbidity were reviewed and some inconsistencies in the data were corrected.

The data system procedures to link morbidities and to link contacts for specific morbidities were used in a number

of different ways to identify episodes for study. One approach was to identify all contacts for a study morbidity where the morbidity was the updated morbidity. Another approach was to identify all the contacts where the study morbidity was both the initial and the updated morbidity.

Generally, all other morbidities occurring at the time of the contacts for the morbidity being studied are included in the data. These morbidities are classified as either related or coexisting. Although classified in this manner, they may or may not be specifically identified as such in the various disease analyses.

It is important to recognize that the approaches do not include contacts with the medical care system where the study morbidity is not present. In other words, a person could experience multiple episodes of other diseases concurrently and have more contacts with the medical care system within the time period observed than are included in the episode of the study morbidity. However, the contacts with the medical care system that involved the study morbidities were the contacts of interest to this study.

The contacts that are used to generate episodes of care also require judgments as to whether subsequent contacts for the same morbidity are a continuation of the episode or the initiation of a new episode. The data system requires that each office visit be identified as either the initial or a

continuing visit for a morbidity. To facilitate the judgments, all morbidities are classified as either representing an acute condition or a chronic condition.

Definition of episodes was more difficult for chronic conditions than for acute conditions. A contact identified as an initial contact for a chronic condition may or may not be the first contact (i.e., initiation of the episode) for the condition. The data system procedures require that the first contact for a chronic condition treated in the KPMCP prior to the initiation of the data system be part of a continuing episode for that chronic condition. An initial contact for a condition is treated as a new episode when no information is available about prior medical history even though it may have been treated outside the KPMCP at some prior time.

Secondly, since episodes of chronic diseases are defined as life-long, the length of the episode is the time between the initial contact for the condition and the last contact with the medical care system for the condition. The last contact with the medical care system may occur for reasons that have nothing to do with the condition in question. The last contact could indicate the subsequent loss of Health Plan eligibility or could merely reflect the end of the period of observation. While these difficulties in defining episodes of chronic conditions do not preclude analysis of chronic conditions in an episodic context, they need to be recognized.

Lastly, because chronic conditions are classified as life-long and because the period of observation encompasses more than seven years, the length of episodes of chronic conditions can show a substantial variation. If such variation is observed, this needs to be recognized in some manner in the analysis of chronic conditions.

Services and Procedures Data

Data identifying all the services and procedures rendered are obtained from physicians' and physician agents' written notes in the outpatient medical record and from other sources of information (e.g., laboratory and x-ray orders or requests, etc.) maintained in the outpatient medical record. Data system procedures require that any contact by a member who is including in the Outpatient Information System have the substance of the contact identified, recorded, and coded.

The basic unit of analysis in the outpatient data system is a morbidity contact. That is, each morbidity identified at the time of the contact is a unit record. The services and procedures rendered during the contact are linked to that morbidity. When multiple morbidities are present at a contact, the services and procedures are assigned to the morbidity for which the services or procedures were intended. This assignment necessitates the judgment of those abstracting the data from the medical records. These judgments are facilitated by data system procedures whereby a set of rules are available to guide these assignments. One rule of particular interest

to this study is the assignment of the office visit to the presenting morbidity. This means that regardless of the number of morbidities present at a contact, an office visit, if there is one, and the total resource use it represents, is assigned to the morbidity that was judged to be the primary reason for the contact. Since office visits are a major component of outpatient medical care, the implications of this particular rule on costs of episodes can be substantial. As a result, this is an important consideration in the analysis of each study morbidity.

The assignment of services and procedures to the morbidity for which they were intended when coupled with maintenance of both the presenting and updated morbidities allows identification of the services and procedures rendered in terms of the original morbidity for which they were intended. It also allows identification of the total bundle of services and procedures that were provided for an episode of care or period of treatment.

The data system codes to identify services and procedures are based upon the 1964 Relative Value Studies prepared by the California Medical Association with some modifications. New codes are added for any new diagnostic or treatment procedures introduced subsequent to 1964. Drugs are coded using a five digit code which identifies the specific drug product, its strength, and dosage form. While these codes provided a comprehensive description of the services and procedures,

several of them necessitate caveats as they apply to this study. The codes for office procedures, while detailed in terms of medical treatment provided and ordered, do not indicate the content of the visit in terms of non-medical treatments that may have been recommended (e.g., exercise, diet, quit smoking) by the provider. The recommendations and the resulting implementation of such treatment alternatives can influence the medical treatment and resources used during the course of the episode.

The coding process also identifies the services and procedures ordered at the time of the contact which may or may not be carried out if they require patient compliance with the providers' orders. For most services and procedures this is not a problem, as coding procedures document the actual receipt of many services and procedures (e.g., physical therapy, mental health, parenteral therapy) or data are available from the medical record to confirm their receipt (laboratory or x-ray results). However, with drugs ordered, there is no reliable information to indicate that drugs ordered by providers were taken by patients. A further limitation with drug data is that these data have a high level of validity only to the extent of identifying a drug by name the first time it is ordered for a morbidity. Thus, the extent of drug treatment and resource use attendant to drug treatment for study morbidities is not readily available or very detailed.

Since the data systems were developed for the purpose of studying medical care utilization, there are various clinical data that could have been useful to this study, but whose collection are not required by data system procedures. Such data include patient's weight, height, blood pressure (i.e., risk factors) and the results of laboratory and radiology procedures.

There is a larger issue that also needs to be recognized when considering the extent of resources used (services and procedures rendered) in episodes of care or periods of treatment. This issue, the outcome of treatment as intended by the provider or as agreed upon by provider and patient, does not appear to be of major importance with acute conditions, as a cure is assumed to be the intended outcome of treatment. However, with chronic conditions, the intended outcome of treatment can vary based upon both patient characteristics and physician characteristics that are brought to the encounter. Different intended outcomes could produce different use of resources. While intent of treatment data are not available from the data system, and may or may not be entered in the medical record, that intent of treatment may contribute to variation in total resource use among chronic conditions needs to be recognized in the analysis of chronic conditions.

SECTION V. OBESITY

Richard E. Johnson

ABSTRACT

Episodes of obesity consisted of all contacts for care where obesity was a diagnosed morbidity at the contact. Obesity is classified as a chronic disease, meaning a person could have only one continuing episode of obesity. The duration of the episode was the time between the first known contact for obesity and the last recorded contact for obesity.

There were 1,706 episodes of obesity, with duration ranging from one contact to 86 months. Sixty-two percent of episodes had no resource use charged to them. Among episodes with resource use, the number of follow-up office visits and laboratory tests accounted for most of the variation in resource use per episode that was explained. Little of the variation in resource use per episode was accounted for by a combination of patient, provider, and medical care process characteristics.

Obesity was a low cost morbidity. This is a cautious interpretation, because obesity was frequently a casual diagnosis and frequently judged not to be the most important reason for a contact for care; also, there was no way to assess the effects of long-term treatment or the lack of it.

INTRODUCTION

Obesity becomes a diagnosis when a provider determines that a person has an abnormally high proportion of body fat. The diagnosis may represent a passing comment on a patient's weight or a serious concern requiring therapy. Various techniques and standards are available for quantifying body fat and for establishing obesity as a diagnosis. Diet, exercise, drug therapy, and surgery are various methods used to treat obesity.

METHODOLOGY

Disease and Episode Definition

Obesity was identified by the International Classification of Diseases, Adapted, 7th edition code 287.0. All contacts for obesity by a 5 percent random sample of Kaiser-Permanente Medical Care Program (KPMCP) members were identified. Obesity associated with pregnancy was excluded from study since it is usually transient.

The contacts included both direct (personal appearance) contacts and indirect (telephone, letter) contacts for care. Only contacts where obesity was an updated presenting or associated morbidity were included. Contacts where obesity is an updated presenting or associated morbidity mean that any care rendered the first time obesity occurs and any subsequent care given for this condition can be coded to obesity.

Obesity is a chronic condition. Each episode is unique to a given person and begins with the date of the first contact in which obesity is an updated presenting or associated

morbidity and ends with the date of the last contact where obesity is an updated presenting or associated morbidity. The length of the episode or the treatment period is the time between the first and last contact so identified. It should be noted that the first or the last contact may be neither the first nor the last contact for the morbidity. Thus, the episode of obesity refers to a period of care within the KPMCP.

Comorbidity Definition

A comorbidity is any condition (other than obesity) that was present and diagnosed at the time of any contact for obesity. Comorbidities may or may not influence the treatment of obesity. If obesity is a complicating factor to the treatment of other diseases, e.g., diabetes, arthritis, heart disease, then the treatment of obesity could be influenced by the presence of such diseases.

Comorbidities during episodes of obesity are recognized in the following manner. The contacts for the most frequent occurring comorbidities were grouped as follows:

1. Medical Examinations Without Sickness (ICDA Y00.0, Y00.5, Y00.8, Y02.0, Y04.9, Y08.0, Y09.2, Y09.4, Y09.6, Y09.7, Y09.8)
2. Endocrine Diseases (ICDA 260.0 Diabetes mellitus] and 250.0-254.9 [Thyroid conditions])
3. Psychotic, Psychophysiologic, Psychoneurotic and Personality Disorders (ICDA 319.0-328.9)
4. Diseases of Bones and Organs of Movement (ICDA 720.0-749.9)

5. Hypertensive Heart Diseases (ICDA 420.0-447.0)

6. Heart (Arterial and Venous) Diseases (ICDA 450.0-467.9)

7. Stomach, Intestinal, Liver, and Pancreatic Diseases (ICDA 540.0-545.9, 570.0-573.9, 576.0-578.5, 580.0-587.9)

8. Other

DESCRIPTIVE ANALYSIS

Episode Description

Utilization

Table 5-1 shows that a substantial share of episodes involved only one contact. More than 90 percent of the episodes involved seven or less contacts and 1 percent of episodes involved more than 20 contacts. The number of contacts per episode ranged from one to 84 and the mean number of contacts per episode was 3.3.

Table 5-2 indicates that 99 percent of episodes involved at least one contact with a physician. The number of contacts with a physician per episode ranged from none to 83 and the mean number of contacts per episode with a physician was 3.2.

These two tables indicate that most episodes of obesity did not involve many contacts for care of the morbidity and that a physician was involved in all but a few of the contacts.

Office Visits and Other Office Procedures

Table 5-3 shows that 2.5 percent of episodes or 42 episodes involved one or more hospital admissions during the episode. An examination of the outpatient medical record

suggested that obesity was not the primary reason for any hospital admission. Further examination of a sample of these hospital admissions in an inpatient data file indicated that obesity was not the primary discharge diagnosis for any of the sample and was not a secondary discharge diagnosis for many of them. An updated outpatient-based diagnosis of obesity does not appear to be a primary cause of hospital-based medical care resource use.

The most frequent office procedure coded to an episode of obesity was an office visit of some type (Table 5-4). The column totals cannot be added because some episodes are represented in both initial and continuing office visits. Nevertheless, it does appear that one or more physician visits were coded to about 25 percent of obesity episodes.

A telephone or letter contact is another type of office procedure that generally involves a physician or his (her) agent. Table 5-4 shows this type of office procedure was coded to obesity one or more times during 18 percent of obesity episodes.

Although most obesity contacts involve physicians, few physician office visits are actually coded to obesity, indicating that obesity is frequently not the primary reason for the contact.

Table 5-4 also shows that there are few initial or continuing mental health visits. These may or may not involve a physician. In summary, 32 percent of episodes of obesity

had one or more office procedures directly coded to the diagnosis and/or treatment of obesity.

Laboratory, Radiology, and Drug Procedures

Table 5-5 indicates that about 15 percent of the episodes of obesity had laboratory procedures coded to them. About one percent of episodes had five or more laboratory procedures. Ten was the largest number of laboratory procedures received in any episode and the mean number of laboratory procedures per episode was 0.3. The specific laboratory procedures in Table 5-6 were those coded to obesity. Less than 1 percent of episodes of obesity had radiology procedures coded to them.

Somewhat less than 5 percent of episodes of obesity had drug orders for the obesity (Table 5-7). Four was the largest number of drug orders for any episode. Among episodes with drug orders, almost 80 percent had drug orders for anorexients (appetite supressants).

Tables 5-3 through 5-7 suggest that the diagnosis and/or treatment during episodes of obesity did not involve hospitalizations, infrequently involved radiology procedures and drugs, more frequently involved laboratory procedures, and most frequently involved some type of office visit.

Another approach to describing the diagnosis and/or treatment of obesity is to identify the procedures that were coded to obesity at the first contact for an episode of obesity. Table 5-8 indicates that an office procedure (physician visit and telephone call) was the most frequent and a

radiology procedure the least frequent at the time of the first contact. This table shows that few procedures were coded to the diagnosis and treatment of obesity at the time of first contact.

Resource Use

The results of converting the procedures for obesity to RVS units are shown in Table 5-9. Excluding drugs, office visits and other office procedures generate about two-thirds of RVS units and laboratory procedures the other third. Radiology contributes a very small share of RVS units coded to episodes of obesity.

The RVS units per episode were tabulated and this distribution is shown in Table 5-10. The most striking result is that more than 60 percent of episodes of obesity had no RVS units or resource use coded to them. The upper limit of RVS units generated by an episode of obesity was 47. The mean RVS units per episode was 1.4. If episodes with no RVS units are excluded, the mean RVS units per episode was 3.6 with the range 0.2 to 47 RVS units.

Patient Characteristics

Females comprised almost two-thirds of the episodes of obesity. Approximately 8 percent of episodes began among persons under 15 years of age while approximately 10 percent of episodes began among persons 65 years of age and over (Table 5-11). More than 50 percent of episodes began with persons 25-54 years of age.

More than 98 percent of persons were eligible Health Plan members at the time of their first contact for obesity. Overall, 3.9 percent of episodes of obesity had one or more contacts when the person was not Health Plan eligible.

Table 5-12 shows the frequencies and the various types of morbidities that occurred within the episodes of obesity. There were 39 episodes or 2.2 percent of episodes that had no other morbidities during the episode. On the other hand, 86.3 percent of episodes had one or more contacts for medical exams without sickness. Hypertensive heart diseases were also a frequent comorbidity and, if arterial and venous diseases of the heart are included, heart-related diseases were a comorbidity in more than one-third of episodes of obesity. About 15 percent of episodes had one or more contact for diabetes and thyroid diseases, for mental or emotional illnesses in general, and for diseases of bones and organs of movement.

Provider Characteristics

Table 5-13 indicates that 80 percent of episodes of obesity began with internists. Other data not shown indicate that internists were the attending physicians for 84 percent of all contacts in episodes of obesity. Pediatricians were the attending physicians at the first contact for 8.4 percent of episodes but were the attending physicians for 5.3 percent of all contacts within episodes of obesity. Similarly, obstetricians-gynecologists (OB-GYNs) were the attendingphysicians at the first contact for 6.3 percent of episodes but were the attending physician for 5.1 percent of all contacts within

episodes of obesity. This suggests that either internists become the attending physician in a number of episodes that initiated with other specialties or that episodes involving internists had more contacts.

The attending physician was designated as regular attending physician in almost 94 percent of the first contacts for an episode of obesity. The attending physician was designated as temporary in 5 percent of first contacts and as a consultant physician in 1 percent of first contacts.

Medical Care Process Characteristics

Forty-three percent of the episodes involved only a single contact (Table 5-14). Table 5-14 also shows that a substantial share of episodes lasted three or more years. The length of episodes or periods of treatment ranged from one day to 86 months (7 years, 2 months) and the mean length was 18 months.

Table 5-15 is a frequency distribution of obesity episodes by the year of the first contact for obesity. The initiation of the data system and data collection in September 1966 explains the smaller number of episodes in that year. Otherwise, the distribution was not unusual.

Table 5-16 shows that obesity was coded as the primary reason for the contact in about 10 percent of the episodes. It was usually coded as the first associated morbidity which suggests it was frequently judged by medical records abstractors to be the second most important reason for the contact. Regardless of whether the presenting or associated

morbidity, it was an established diagnosis in 97.8 percent of these contacts. In other words, obesity was established as a diagnosis by the physician at the time of the first contact for almost all episodes.

The first contact for the episode of obesity was not necessarily the beginning of the episode. The first contact was coded as a part of a continuing episode in 297 or 17.5 percent of the episodes of obesity. This means that these episodes had begun within the KPMCP and at a time prior to the first recorded contact for obesity.

More than 93 percent of first contacts for an episode of obesity had one or more morbidities at that contact (Table 5-17). Also, more than 16 percent of the episodes had four or more comorbidities at the first contact.

Table 5-18 shows that almost 95 percent of first contacts for episodes of obesity occurred at the medical office. Most of the remaining first contacts were by telephone or letter with almost all of these being telephone contacts. For all episodes, almost 86 percent of contacts were in the medical office and almost 13 were by telephone and letter.

Approximately 94 percent of first contacts at medical offices for episodes of obesity were regularly scheduled contacts with the remaining 6 percent walk-in or not regularly scheduled contacts. These percentages were similar when all contacts during the episodes of obesity are included.

Ninety-nine percent of first contacts for episodes of obesity occurred during regular medical office hours. This

percentage was similar for all contacts during the episodes of obesity.

In summary, these data indicate that, for the most part, episodes of obesity showed little variation in the medical care process. At least 90 percent of the time obesity was not the primary reason for the contact; episodes occurred with one or more comorbidities; obesity was established as a diagnosis at first contact; and episodes generally occurred as regularly scheduled contacts and at regular medical office hours.

Episodes of obesity did show some variation in whether or not the episode began with a continuing contact for obesity and whether an episode that began with a medical care contact continued to generate medical care contacts. A substantial amount of variation was shown in the length of episodes of obesity.

BIVARIATE ANALYSIS

The descriptive analysis showed that 61.8 percent of all episodes of obesity had no RVS units coded to them, that is, had no resource use coded to the period of treatment. It was determined that no resource use was, by definition, a treatment bundle equal to zero RVS units. Therefore, subsequent analyses are made using no resource use as a distinct treatment bundle.

The absence of variation led to the exclusion of the following variables from further analysis:

1. Health Plan eligibility of members during the episode

2. Physician status whether regular, temporary or consultant
3. Status of diagnosis whether established, tentative, or unknown
4. Time of contacts

The remaining patient, provider and medical care process variables were examined to determine whether any resources were coded to the episode and, if so, the extent of resource use.

Patient Characteristics

Table 5-19 shows that resource use was significantly related to sex. Females were more likely to have had resource use during the episode of obesity and the amount of resource use among females was significantly greater than for males.

Resource use was also significantly related to age (Table 5-20). Obesity episodes in the age group 0-14 years were less likely to have resource use than the other age groups, but had the highest mean RVS units per episode among the age groups.

Table 5-21 shows that all first contacts of obesity where no other morbidities were present had some resource use. However, the number of different comorbidities at first contact did not appear to influence whether or not there was resource use coded to the obesity. The mean number of RVS units coded to each episode of obesity did not differ significantly on the basis of whether or not a comorbidity was present and the number of comorbidities present at the first contact.

Whether or not resource use was coded to an episode of obesity was significantly related to the number of contacts for medical exams without sickness that occurred during the episode of obesity (Table 5-22). Episodes of obesity with three or more contacts for such medical exams were the most likely to have resource use assigned. The mean number of RVS units per episode was directly and significantly related to the number of contacts for medical exams without sickness during the episode.

Tables 5-23 through 5-29 show that resource use during the episode of obesity was significantly related to the number of concurrent contacts for (1) diabetes and thyroid-related morbidities, (2) mental or emotionalrelated disease, (6) diseases of the bones and organs of movement, and morbidities, (3) gastrointestinal and related morbidities, (4) hypertensive heart disease, (5) arterial or venous heart (7) sprain and strain morbidities, during the episode.

The mean number of RVS units per episode was, however, directly and significantly related only to the number of contacts for mental and emotional-related morbidities and for sprain and strain morbidities during the episode. These data resource use coded to the obesity. The mean number of RVS units coded to each episode of obesity did not differ significantly on the basis of the whether or not a comorbidity was present and the number of comorbidities present at the first contact.

suggest that while of resource use is related to the types of comorbidities identified, their presence with some exceptions is not likely to influence the intensity of the treatment of obesity.

Provider Characteristics

Whether or not resource use occurred during the episode of obesity was significantly related to the specialty of the physician at the first contact (Table 5-30). Episodes of obesity treated by pediatricians at the first contact were the least likely to have resource use assigned while episodes treated by OB-GYNs were the most likely to have resource use assigned. The mean number of RVS units per episode was not significantly related to physician specialty at first contact. However, pediatricians had the highest mean number of RVS units per episode. This is consistent with the previous information indicating the age group 0-14 years of age had the largest mean number of RVS units per episode among the different age groups.

Medical Care Process Characteristics

Resource use was significantly related to the year the episode began (Table 5-31). The earlier the year the episode began the more likely any resource use. The mean number of RVS units per episode was significantly related to the year the episode began. No clear pattern to this relationship was indicated.

Resource use was significantly related to the length of the episode or treatment period (Table 5-32). The longer the episode the more likely any resource use. The mean number of RVS units per episode was significantly and directly related to the length of the episode of obesity.

Resource use was also significantly related to whether obesity was the presenting or an associated morbidity at the time of the first contact (Table 5-33). When obesity was the presenting morbidity at the first contact, there was always, by definition, resource use.

Table 5-34 shows that resource use was significantly related to whether or not the first contact was the initial or continuing visit for obesity. Resource use was more likely when the contact was for a continuing episode of obesity. The mean number of RVS units per episode was not significantly related to the status of the episode.

Resource use was also significantly related to whether the first contact was regularly scheduled or other than regularly scheduled (Table 5-35). The mean number of RVS units per episode did not differ significantly by the type of appointment.

Table 5-36 shows that resource use was significantly related to whether or not a return visit was requested at the time of the first contact. Resource use was more likely at the first contact when a return visit was requested. The mean number of RVS units per episode did not differ on the basis of

whether or not a return visit was requested at the time of the first contact for obesity.

The results of these analyses can be used to characterize the episodes of obesity that had no resource use coded to the episode. The episodes were likely to:

1) be with male members
2) be with members under 0-14 years of age or to be treated by pediatricians or other than internists or OB-GYNs at the first contact of the episode
3) have comorbidities at the first contact of the episode
4) have fewer contacts during the episode with the most frequent occurring comorbidities
5) have begun in recent years or be shorter in length
6) have obesity an associated morbidity at the first contact of the episode
7) have the first contact the initial visit of the episode
8) involve regularly scheduled visits
9) have fewer return visits requested.

One further step attempted to identify those characteristics that best differentiated episodes with no resource use. Discriminant analysis was used and episodes were classified into those one contact in duration, those from two contacts to 48 months in duration and those 49 months or longer in

duration. In addition, the variables included in the analysis were basically those that characterized the whole episode rather than just the first contact of the episode.

Table 5-37 shows that episodes of obesity without resource use were significantly (when all other variables are statistically controlled) more likely to be among males regardless of the duration of the episode. One-contact episodes without resource use were also significantly more likely to occur among older persons, were more likely to have comorbidities at the first contact, were more likely to have a physical exam, and were more likely to have a heart-related morbidity. Among the longest episodes without resource use, they were significantly less likely to have contacts for mental/emotional diseases during the episode in addition to more likely being episodes among males. Being male, the presence of other morbidities at the time obesity was diagnosed, and having contacts for medical exams without sickness during episodes of obesity were the factors that appeared to best differentiate the episodes without resource use from those with resource use. Two possible interpretations of these results are that obesity is not likely to involve resource use when diagnosed at the time of medical exams without sickness and that resource use is not likely to be coded to obesity in the presence of other diseases concurrent with obesity.

rate of resource use (mean number of RVS units per month) was calculated. The results indicated that this rate was higher for episodes of less than one year's duration than for episodes of one year or more duration. In addition, for episodes of one year or longer, the rate decreased but not substantially as the length of episode increased. As a result, the episodes for analysis were broken down into two groups, those with a duration of less than a year and those with duration of one year or more.

Utilization (Episodes less than one year in duration)

The total number of RVS Units assigned to the episode is used as the dependent variable. The results indicate that the utilization measures were able to account for approximately 50 percent of the variation in resource use among episodes less than one year in duration. Figure 5-2 shows that the number of laboratory tests in the episodes accounted for almost 36 percent of the variation in resource use. For those having none or one laboratory tests during the episode, an additional 5 percent of variation in resource use is accounted for by whether or not an initial DOV was coded to the episode. For those with none or one laboratory procedures and no initial visit assigned, an additional 3 percent of the variation in resource use is explained by the number of follow-up doctor office visits (DOVs) coded to the episode and whether none or one laboratory procedure was received.

For episodes with none or one laboratory procedure and with an initial DOV assigned to the episode, an additional 2.6 percent of the variation was explained by the number of physician contacts in the episode. While no RVS units were assigned this measure, it was intended to serve as a surrogate for the combined influence of DOVs, initial and follow-up, drug orders, and laboratory and radiology procedures upon resource use. It was asserted that the more physician contacts for obesity the greater the likelihood of DOVs, laboratory and radiology procedures, and drug orders being coded to obesity. However, the manner in which this measure influenced resource use does not fully support the assertion.

For episodes with two or more laboratory procedures, an additional 2.6 percent of the variation in resource use was accounted for by the number of physician contacts. Again, the manner in which this measure influenced resource use does not fully support what it was intended to measure.

Utilization (Episodes one year or longer in duration)

For these episodes of obesity, the dependent variable was the number of RVS units per month. Figure 5-3 shows that approximately 30 percent of the variation in resource use was accounted for by the utilization measures. The largest amount of variation in resource use was explained by the number of follow-up DOVs assigned to the episode (13.1 percent). For those episodes with none to two follow-up DOVs an additional 6.4 percent of variation in resource use was explained by the

number of laboratory procedures during the episodes. Little additional variation in resource use for these episodes was explained by the utilization measures.

For episodes with three or more follow-up DOVs assigned to the episode, an additional 8.5 percent of the variation in resource use is explained by the number of telephone or letter contacts. Since this type of contact is almost completely telephone, a possible explanation for the nature of the impact would be that episodes with no telephone contact (substitute personal contacts) and episodes with the greatest number of telephone contacts (complement personal contacts) would be more likely to have personal contact and associated DOVs and laboratory and radiology procedures than episodes with one telephone contact.

Since this analysis did not contribute much to further explaining the variation in resource use in episodes of obesity, a similar analysis was made using the total number of RVS units per episode as the dependent variable. While the results are not shown, the same variables appeared to account for resource use to a similar extent.

Another approach involved episodes of obesity that occurred during 1972 and 1973 and included as an independent variable whether the episode had none or one or more drug orders. The intent was to determine if the presence of drug treatment contributed to further explaining variation in resource use. The limited number of episodes receiving one or

more drug orders was not sufficient to permit any effect from drug treatment to be shown.

The various analyses have shown that the measures of utilization explain less than 50 percent of the variation in resource use for episodes of obesity of varying duration. This suggests that the nature and the amount of treatment during episodes of obesity vary substantially.

Patient, Provider, and Medical Care Process

The extent to which patient, provider, and medical care process characteristics explained the variation in resource use in episodes of obesity was also examined. The first attempt involved episodes less than one year in duration with resource use (the dependent variable) the total number of RVS units assigned the episode. The results are shown in Figure 5-4.

The figure shows that the total amount of variation explained by these variables was 13.2 percent. The age group to which the person belonged at the time of the first contact for obesity explained the largest amount of the variation (4.2 percent). The year when the episode began, the number of co-morbidities at the first contact for obesity and the number of contacts for medical exams without sickness were the other characteristics that contributed to explaining the variation in resource use.

The second analysis involved episodes of obesity with a duration of one year or more and resource use per episode, the

number of RVS units per month that were assigned to the episode. The results are shown in Figure 5-5.

The figure shows that the total amount of variation accounted for was 10.5 percent. No one variable contributed substantially to explaining the variation in resources used. Those that did contribute were the number of contacts in the episode for diseases identified as mental and/or emotional disorders, the age group of the person at the time of the first contact for obesity, the year the episode originated, the number of contacts in the episode for hypertensive heart disease, and the number of comorbidities at the first contact for the episode.

The patient, provider, and medical care process characteristics, which were largely patient characteristics, did not explain much of the variation in resource use in episodes of obesity. The results suggest that age and the type and extent of other diseases that the patient has at the time of the contacts for obesity can have some influence upon resource use.

The inability to identify treatment bundles that accounted for the major share of the variation in resource use among episodes of obesity resulted in foregoing the multiway table and log linear model technique. Instead, the treatment bundles that accounted for the most resource use per episode were examined to determine if high resource use involved all types of resources, and if certain patient, provider, and

medical care process characteristics were more likely to be seen with high resource use.

Initially, the analysis was made among episodes with a duration of less than one year. Three treatment bundles accounted for about 40 percent of the variation in resource use in episodes of obesity. The treatment bundle, the mean RVS units per episode and the number of episodes for each bundle were:

1. 0-1 laboratory procedures, no initial DOV for obesity, $\overline{y} = 1.3$, N = 100
2. 0-1 laboratory procedures, an initial DOV for Obesity, $\overline{y} = 2.8$, N = 45
3. 2 or more laboratory procedures, $\overline{y} = 5.2$, N = 56

The episodes with the highest mean resource use (bundle 3) had at least twice as much resource use as episodes in the other two treatment bundles. When compared with treatment bundles 1 and 2, episodes with treatment bundle 3 were not likely to have more physician contacts, follow-up DOVs, contacts with hospital admissions, telephone/letter contacts, and telephone contacts about prescription refills per episode. They were also not likely to have drug orders. They were, however, far more likely to have the frequently occurring laboratory procedures. These data suggest that high resource use for episodes of obesity less than one year in length was attributable to laboratory procedures without concomitant high use of office procedures and drug treatment.

The episodes (bundle 3) with the highest resource use were more likely than other episodes with treatment bundles 1 and 2 to have an associated morbidity at first contact for the episode and to have one or more contacts for a medical exam without sickness during the episode.

A similar analysis was made among episodes of obesity that were one year or longer in duration. Five treatment bundles accounted for somewhat less than 30.0 percent of the variation in resource use among these episodes. The treatment bundle, the mean rate of RVS units per episode and the number of episodes in each bundle are:

1. No follow-up DOVs, 0-1 laboratory procedures, $\bar{y} = 3.3$, N = 71
2. 1-2 follow-up DOVs, 0-1 laboratory procedures, $\bar{y} = 6.2$, N = 106
3. 0-2 follow-up DOVs, 2 or more laboratory procedures, $\bar{y} = 14.2$, N = 45
4. 3 or more follow-up DOVs, 1 telephone/letter contact, $\bar{y} = 13.3$, N = 40
5. 3 or more follow-up DOVs, 0 or 2 or more telephone/letter contacts, $\bar{y} = 32.1$, N = 16

Episodes with treatment bundle 5 had more than twice the mean resource use than episodes with any other treatment bundle. Among bundle 5, more than one-half of these episodes had two or more laboratory procedures and all episodes had five or more physician contacts. This suggests that high resource use

among episodes of obesity one year or longer in duration involves all types of resource use. Episodes with treatment bundle 5 were also more likely than with other episodes to have contact and multiple contacts for emotional and mental--related morbidities during the episode.

SUMMARY AND CONCLUSIONS

More than 60 percent of the episodes of obesity had no resource use. Among episodes with resource use, such use was not substantial even though the mean duration of episodes was 18 months.

Obesity was a low cost morbidity in terms of the resource costs it generated over a defined time period. However, such an interpretation does not include the possible long-term resource costs that obesity may cause, such as those of hypertension induced by obesity.

Most resource use in the care of obesity was associated with office visits. The recommended treatment for obesity is dieting and physical activity. If there is time spent by providers communicating these regimens during an office visit, it is recognized only when obesity is the presenting morbidity or primary reason for the contact.

Laboratory procedures directed to ruling out organic causes for obesity, primarily diabetes and thyroid disease represent the greatest source of variation in treatment. While no resource use was derived for drugs, they were used infrequently in the treatment of obesity. Drastic surgical procedures to treat obesity are not used in the KPMCP.

Specific combinations of medical services, identified as treatment bundles, were not able to account for a major share of the variation in resource use among episodes of obesity.

The major resources used in shorter episodes were laboratory procedures. These can reflect a search for the cause of obesity. In longer episodes the major factor was follow-up office visits which can reflect the physician-directed continuing care of obesity. While such interpretations are apparent, the amount of variation in resource use that was explained by various treatment bundles was not substantial given the cause-effect relationship between utilization and resource use. This suggests that patterns of treatment for obesity are not clearly differentiated and identifiable when considered in an episode context.

The interpretations concerning the limited economic impact of episodes of obesity and the lack of clearly identifiable modes of treatment for episodes of obesity require some discussion of the available data. Episodes of obesity identified for analysis appear to vary in terms of the clinical precision applied to establishing the diagnosis and to vary by potential severity of the disease. The diagnosis of obesity is recorded by an abstractor whenever the medical record contains notations that the patient is overweight to obese. At the time of a medical exam without sickness, overweight might be a casual notation by the physician in summarizing the results of the exam. A similar observation would probably not

be noted if the patient presented for an upper respiratory infection (URI). On the other hand, an overweight condition would likely be recorded as obesity if a patient had an endocrine disease, a heart disease or a bone or joint disease as the presenting condition since obesity is a complicating factor with such disease conditions. Thus, while an extremely obese person would probably receive a diagnosis of obesity, the less obese may or may not be diagnosed depending upon the health of the person at the time of contact with the medical care system. The available data suggest these assertions but do not prove them.

A second problem relates to the manner in which office procedures are or are not coded to a morbidity. It was observed that very few episodes of obesity occur without the presence of comorbidities and these comorbidities are most frequently chronic diseases. As a result, the diagnosis of obesity is infrequently indicated as the primary (presenting) reason for the contact and much of the resource use that might be reasonably coded to obesity is coded to the presenting (other than obesity) chronic disease.

It would also appear that the clinical situation in which the diagnosis of obesity was made, whether or not obesity was the presenting morbidity, might also influence the resource use coded to its treatment. For example, the casual written observation of overweight as a result of a physician exam but recorded as obesity is probably less likely to be treated in

any manner than an observation of overweight and diagnoses of obesity in the presence of various chronic conditions.

Another possible reason for the inability to clearly define patterns of treatment for episodes of obesity could be individual physician variation in the diagnostic assignment of obesity and in the treatment procedures used when diagnosed.

The results also showed that little of the variation in resource use during episodes of obesity both short and long-term was explained by patient, provider, and medical care process characteristics, individually or collectively. Patient factors involving the age of the patient and the number and types of other conditions that the patient had along with the diagnosis of obesity were responsible for most of the variation explained.

The inability of these factors to account for much of the variation in resource use could be because there was little variation in physician characteristics and little variation in the medical care process characteristics that were associated with the care of obesity. In other words, the variation in resource use could not result from variation in most of the physician or medical care system characteristics that were available. Lastly, the inability to clearly differentiate treatment bundles could also hinder identifying the influence of these factors.

In conclusion, the interpretations that obesity is a low cost morbidity is a cautious interpretation. To subject the

episodes of obesity as identified to a more detailed cost analysis requires uniform diagnostic criteria and the inability to assess long-term effects of treatment or lack thereof. Standard clinical criteria are needed to establish obesity as a diagnosis, and obesity should be the only morbidity diagnosed during the period of care, or be diagnosed in the presence of other morbidities where obesity is not a potentially complicating factor. On the other hand, in the presence of various chronic diseases, (e.g., hypertension, diabetes, anxiety tension) obesity may be a potential indicator of the severity of such diseases. Thus, the medical approach to obesity may reflect the nature and severity of the concurrent disease.

Table 5-1
Episodes of Obesity by Total Number of Contacts in Episode

Number of Contacts	No. of Episodes	Pct.	Cum Pct.
1	729	42.7	42.7
2	314	18.4	61.1
3	196	11.5	72.6
4	120	7.0	79.6
5	81	4.7	84.3
6	56	3.3	87.6
7	47	2.7	90.3
8	35	2.1	92.4
9	22	1.3	93.7
10	18	1.1	94.8
11-15	52	3.0	97.8
16-20	19	1.2	99.0
More than 20	17	1.0	100.0
Total	1706	100.0	

Range	1-84
Mean	3.3 ± SE 0.1
Median	1.9

Table 5-2
Episodes of Obesity by Total Number of Physician Contacts in Episode

Number of Contacts	No. of Episodes	Pct.	Cum Pct.
0	17	1.0	
1	723	42.4	43.4
2	315	18.5	61.9
3	192	11.3	73.2
4	123	7.2	80.4
5	77	4.5	84.9
6	58	3.4	88.3
7	45	2.6	90.9
8	34	2.0	92.9
9	22	1.2	94.1
10	20	1.2	95.3
11-15	50	2.9	98.2
16-20	15	0.9	99.1
More than 20	15	0.9	100.0
Total	1706	100.0	

Range	0-83
Mean	3.2 ± SE 0.1
Median	1.9

Table 5-3
The Number of Hospital Admissions in Episode

Number of Hospital Admissions	Number of Episodes	Pct.	Cum Pct.
0	1664	97.5	
1	30	1.8	99.3
2	9	0.5	99.8
3 or more	3	0.2	100.0
Total	1706	100.0	

Table 5-4
Episodes of Obesity by Number of Office Procedures in Episode

Number	Office Visits								Mental Health Visits				Telephone and Letter	
	Initial		Continuing		With Exam		For Refill		Initial		Follow-up			
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
1	79	4.6	205	12.0	13	0.8	3	0.2	9	0.5	4	0.2	204	12.0
2			76	4.5			1	0.1			2	0.1	55	3.2
3			33	1.9									18	1.0
4			18	1.1							2	0.1	20	1.2
5			11	0.6									6	0.4
6			10	0.6							1	0.1	6	0.4
more than 6			22	1.3									13	0.8
Total	79	4.6	375	22.0	13	0.8	4	0.3	9	0.5	9	0.5	322	18.0

Table 5-5
Episodes of Obesity by Number of Laboratory Procedures in Episode

Number of Lab Procedures	Number of Episodes	Pct.	Cum Pct.
0	1452	85.1	
1	111	6.5	91.6
2	92	5.4	97.0
3	18	1.1	98.1
4	13	0.8	98.9
5	8	0.5	99.4
More than 5	12	0.6	100.0
Total	1706	100.0	

Range 1-10

Mean 0.3 ± SE .02

Table 5-6
Number of Specific Laboratory Procedures for Episodes of Obesity

Laboratory Procedures	No.	Pct. of all Lab. Proc.	Cum Pct.
T_4	127	24.2	
T_3	79	15.0	39.2
Glucose	49	9.3	48.5
Cholesterol	48	9.1	57.6
PBI	36	6.9	64.5
Urinalysis	22	4.2	68.7
Glucose Cola	17	3.2	71.9
Hematocrit	17	3.2	75.1
BUN	16	3.0	78.1
Other	114	21.9	100.0
Total	525	100.0	

Table 5-7
Episodes of Obesity by Number of Drugs Ordered in Episode

Number of Drugs Ordered	Number of Episodes	Pct.	Cum Pct.
0	395	95.4	
1	14	3.4	98.8
More than 1	5	1.2	100.0
Total	414*	100.0	

Range 1-4

*Drug order data were available for episodes of obesity in 1972 and 1973.

Table 5-8
Procedures During First Contact of Episodes of Obesity

Procedure	No. of Episodes	Pct. of Episodes
Hospital Admissions	13	0.8
Physician Visit	117	6.9
Telephone Call	55	3.2
Laboratory	117	6.9
Radiology	4	0.2
Drug Order	10	2.4*

*Based upon 414 episodes in 1972 and 1973

Table 5-9
RVS Units by Procedure* Assigned to Episodes of Obesity

Procedure	RVS Units	Pct.
Office	1533	66.2
Laboratory	752	32.5
Radiology	32	1.3
Total	2317	100.0

*Exclude Drugs Ordered

Table 5-10
Episode of Obesity by RVS Units in Episode

RVS	Number of Episodes	Pct.	Cum Pct.
0	1054	61.8	
0.1 - 1.0	226	13.2	75.0
1.1 - 2.0	133	7.8	82.8
2.1 - 3.0	69	4.0	86.8
3.1 - 4.0	79	4.6	91.4
4.1 - 5.0	42	2.5	93.9
5.1 - 10.0	66	3.9	97.8
10.1 - 15.0	23	1.3	99.1
more than 15.0	14	0.9	100.0
Total	1706	100.0	

All Episodes		Episodes with RVS > 0	
Range	0-47	Range	0.2-47
Mean	1.4 ± SE .09	Mean	3.6

Table 5-11
Episodes of Obesity by Age As of Date of First Service for Obesity

Age	No. of Episodes	Pct.	Cum Pct.
0-5	15	0.9	
5-14	121	7.1	8.0
15-24	229	13.4	21.4
25-34	310	18.2	39.6
35-44	275	16.1	55.7
45-54	322	18.9	74.6
55-64	261	15.3	89.9
65-74	139	8.2	98.1
75 and over	31	1.9	100.0
Total	1703*	100.0	

*Age not known for three persons

Table 5-12
Episodes of Obesity with Contacts for Morbidities Other than Obesity

Co-Morbidity	Pct. No Contacts	Pct. One or More Contacts
Diabetes and Thyroid Disease	85.5	14.5
Psychotic, Psychophysiologic Psychoneurotic and Personality Disorders	83.5	16.5
Diseases of Bones and Organs of Movement	85.0	15.0
Sprains and Strains	96.3	3.7
Hypertensive Heart Diseases	71.6	28.4
Arterial and Venous Diseases of the Heart	91.6	8.4
Stomach, Intestinal, Liver and Pancreatic Diseases	91.4	8.6
Medical Exam or Special Conditions without Illness	13.7	86.3

Table 5-13
Specialty of Physician at First Contact for Obesity

Specialty	Number of Episodes	Pct.	Cum Pct.
Internal Medicine	1367	80.1	
Pediatrics	144	8.4	88.5
OB-GYN	107	6.3	94.8
Other*	88	5.2	100.0
Total	1706	100.0	

*Other includes all other specialties as well as new health practitioners

Table 5-14
Length of Episodes of Obesity

Length of Episode	Number of Episodes	Pct.	Cum Pct.
One contact (one day)	733	43.0	
2 days to 6 months	189	11.1	54.1
6 months to 1 year	92	5.4	59.5
1 - 2 years	151	8.9	68.4
2 - 3 years	148	8.7	77.1
3 - 4 years	133	7.8	84.9
4 - 5 years	109	6.4	91.3
5 - 6 years	93	5.3	96.6
more than 6 years	58	3.4	100.0
Total	1706	100.0	

Table 5-15
Year of First Contact for Episodes of Obesity

Year	Number of Episodes	Pct. of Episodes
1966	70	4.1
1967	302	17.7
1968	211	12.4
1969	249	14.6
1970	254	14.9
1971	206	12.1
1972	200	11.7
1973	214	12.5
Total	1706	100.0

Table 5-16
Status of Obesity at First Contact

Morbidity	Number of Episodes	Pct.
Presenting	176	10.3
First Associated	1044	61.2
Second Associated	315	18.5
Third Associated	111	6.5
4th to 8th Associated	60	3.5
Total	1706	100.0

Table 5-17
Number of Co-morbidities at First Contact for Obesity

Co-Morbidities	Number of Episodes	Pct.
0	112	6.6
1	524	30.7
2	474	27.8
3	315	18.5
4 or more	281	16.4
Total	1706	100.0

Table 5-18
Place of Service
First Contact for Obesity

Place	Number of Episodes	Pct.
Medical Office	1616	94.7
Emergency Room	8	0.5
Hospital	13	0.8
Telephone or Letter	68	4.0
Total	1705*	100.0

*One other than listed

Table 5-19
Resource Use in Episodes of Obesity by Sex of Person

Resource Use	Pct. of Episodes Males	Pct. of Episodes Females	All Episodes
No	72.4	56.2	61.8
Yes	27.6	43.8	38.2
	100.0	100.0	100.0
Total	N = 590	N = 1116	N = 1706

$X^2 = 42.1$, 1df, $p < .001$
Contingency Coefficient (CC) = .15

If Yes, Resource Use

Mean Number of RVS Units/Episode by Sex

	Number of Mean RVS Units/Episode	Number of Episodes
Male	2.7	163
Female	3.8	489
Both	3.6	652

$F = 5.4$, $p = .02$

Table 5-20
Resource Use by Age at First Contact for Episodes of Obesity

Resouce Use	Pct. of Episodes 0-14 years of age	Pct. of Episodes 15-44 years of age	Pct. of Episodes 45 years of age and over	Pct. All Episodes
No	77.9	59.0	61.8	61.8
Yes	22.1	41.0	38.2	38.2
	100.0	100.0	100.0	100.0
Total	N = 136	N = 814	N = 753	N = 1706

$X^2 = 17.8$, 2df., $p < .001$

CC = .10

Gamma = .05

If yes, Resource Use

Mean Number of RVS Units/Episodes by Age at First Contact

Age	Mean Number of RVS Units/Episodes	Number of Episodes
0-14	4.5	30
15-44	4.0	334
45 and over	2.9	288
All	3.6	652

$F = 3.5$, $p = .03$, $r = -.10$

Table 5-21
Resource Use by Number of Comorbidities at First Contact for Episode

Resource Use	Pct. of Episodes None	Pct. of Episodes One	Pct. of Episodes Two	Pct. of Episodes Three	Pct. of Episodes Four or More	Pct. All Episodes
No	0	64.5	67.7	67.0	65.5	61.8
Yes	100.0	35.5	32.3	33.0	34.5	38.2
Total	100.0 N=112	100.0 N=524	100.0 N=474	100.0 N=315	100.0 N=281	100.0 N=1706

If yes, Resource Use

Mean Number of RVS Units per Episode by Number of Comorbidities at First Contact

	Mean No. of RVS Units/ Episodes	No. of Episodes
None	3.9	112
One	3.5	186
Two	3.8	153
Three	3.1	104
Four or More	3.3	97
Total	3.6	652

F = 13.5, p = .76, r = -.04

Table 5-22

Resource Use by Number of Contacts for Medical Exams Without Sickness During Episodes of Obesity

Resource Use	Pct. of Episodes No Contacts	Pct. of Episodes One Contact	Pct. of Episodes Two Contacts	Pct. of Episodes Three or More Contacts	Pct. All Episodes
No	54.3	75.8	56.1	36.5	61.8
Yes	45.7	24.2	43.9	63.5	38.2
Total	100.0 N=234	100.0 N=828	100.0 N=326	100.0 N=318	100.0 N=1706

$X^2 = 165.6$, 3 df, $p < .001$

$CC = .31$

$Gamma = .30$

If yes, Resource Use

Mean No. of RVS Units per Episode by Number of Contacts for Medical Exam Without Sickness During Episodes of Obesity

	Mean No. of RVS Units./ Episodes	No. of Episodes
No Contacts	2.6	107
One	2.7	200
Two	3.1	143
Three or More	5.2	202
Total	3.6	652

$F = 10.2$, $p < .001$, $r = .19$

Table 5-23
Resource Use by Number of Contacts for Diabetes and Thyroid-Related Diseases During Episodes of Obesity

Resource Use	Pct. of Episodes No Contact	Pct. of Episodes One Contact	Pct. of Episodes Two or More Contacts	Pct. All Episodes
No	64.9	59.5	28.3	61.8
Yes	35.1	40.5	71.7	38.2
Total	100.0 N = 1458	100.0 N = 121	100.0 N = 127	100.0 N = 1706

$X^2 = 66.3$, 2df., $p<.001$

CC = .20

Gamma = .42

If Yes, Resource Use

Mean Number of RVS Units/Episode by the Number of Contacts for Diabetes and Thyroid-Related Diseases During Episodes of Obesity

	Mean No. of RVS Units/Episodes	No. of Episodes
No Contacts	3.5	512
One	3.2	49
Two or More	4.3	91
Total	3.6	652

F = 1.0, p = .37, r = .05

Table 5-24
Resource Use by Number of Contacts for Mental or Emotional-Related Diseases During Episodes of Obesity

Resource Use	Pct. of Episodes No Contact	Pct. of Episodes One Contact	Pct. of Episodes Two or More Contacts	Pct. All Episodes
No	65.0	55.1	31.3	61.8
Yes	35.0	44.9	68.7	38.2
Total	100.0 N = 1424	100.0 N = 167	100.0 N = 115	100.0 N = 1706

$X^2 = 54.8$, 2df., $p<.001$

CC = .18

Gamma = .39

If Yes, Resource Use

Mean Number of RVS Units/Episode by the Number of Contacts with Mental or Emotional-Related Diseases During Episodes of Obesity

	Mean No. of RVS Units/Episodes	No. of Episodes
No Contacts	3.1	498
One	3.7	75
Two or More	6.4	79
Total	3.6	652

$F = 13.7$, $p < .001$, $r = .19$

Table 5-25
Resource Use by Number of Contacts for Gastrointestinal and Related Diseases During Episodes of Obesity

Resource Use	Pct. of Episodes No Contacts	Pct. of Episodes One or More Contacts	Pct. All Episodes
No	63.1	47.9	61.8
Yes	36.9	52.1	38.2
Total	100.0 N = 1560	100.0 N = 146	100.0 N = 1706

$X^2 = 12.3$, 1 df., $p < .001$

CC = .09

If yes, Resource Use

Mean Number of RVS Units/Episode by Number of Contacts for Gastrointestinal and Related Diseases During Episodes of Obesity

	Mean No. of RVS Units/Episode	No. of Episodes
No Contacts	3.5	576
One or More	3.6	76
Total	3.6	652

F = .01, p = .91

Table 5-26
Resource Use by Number of Contacts for Hypertensive Heart Diseases During Episodes of Obesity

Resource Use	Pct. of Episodes No Contacts	Pct. of Episodes One Contact	Pct. of Episodes Two Contacts	Pct. of Episodes Three or More Contacts	Pct. All Episodes
No	64.8	72.4	53.7	35.6	61.8
Yes	35.2	27.6	46.3	64.4	38.2
Total	100.0 N=1221	100.0 N=199	100.0 N=95	100.0 N=191	100.0 N=1706

$X^2 = 72.2$, 3 df, $p < .001$

CC = .21

Gamma = .25

If yes, Resource Use

Mean Number of RVS Units per Episode by Number of Contacts with Hypertensive Heart Diseases During Episodes of Obesity

	Mean No. of RVS Units./ Episodes	No. of Episodes
No Contacts	3.6	430
One	2.1	55
Two	4.1	44
Three or More	3.8	123
Total	3.6	652

F = 1.5, p= .22, r = .01

Table 5-27
Resource Use by Number of Contacts for Arterial or Venous Heart Disease During Episodes of Obesity

Resource Use	Pct. of Episodes No Contacts	Pct. of Episodes One or More Contacts	Pct. All Episodes
No	62.8	51.0	61.8
Yes	37.2	49.0	38.2
Total	100.0 N = 1563	100.0 N = 143	100.0 N = 1706

X^2 = 7.1, 1 df., p=.004

CC = .07

If yes, Resource Use

Mean Number of RVS Units/Episode by Number of Contacts for Arterial or Venous Heart Disease During Episodes of Obesity

	Mean No. of RVS Units/Episode	No. of Episodes
No Contacts	3.6	582
One or More	3.5	70
Total	3.6	652

F = .02, p = .90

Table 5-28
Resource Use by Number of Contacts for Diseases of the Bone and Organs of Movement During Episodes of Obesity

Resource Use	Pct. of Episodes No Contact	Pct. of Episodes One Contact	Pct. of Episodes Two or More Contacts	Pct. All Episodes
No	62.7	60.8	50.9	61.8
Yes	37.3	39.2	49.1	38.2
Total	100.0 N = 145	100.0 N = 148	100.0 N = 108	100.0 N = 1706

X^2 = 6.0, 2df., p=.05

CC = .06

Gamma = .13

If Yes, Resource Use

Mean Number of RVS Units/Episode by the Number of Contacts for Diseases of the Bones and Organs of Movement During Episodes of Obesity

	Mean No. of RVS Units/Episodes	No. of Episodes
No Contacts	3.4	541
One	4.2	58
Two or More	4.8	53
Total	3.6	652

F = 2.3, p = .10, r = .08

Table 5-29
Resource Use by Number of Contacts for Sprains and Strains During Episodes of Obesity

Resource Use	Pct. of Episodes No Contacts	Pct. of Episodes One or More Contacts	Pct. All Episodes
No	62.3	47.6	61.8
Yes	37.7	52.4	38.2
Total	100.0 N = 1643	100.0 N = 63	100.0 N = 1706

$X^2 = 5.0$, 1 df., $p = .03$

CC = .06

Gamma = .29

If yes, Resource Use

Mean Number of RVS Units/Episode by Number of Contacts for Sprains and Strains During Episodes of Obesity

	Mean No. of RVS Units/Episode	No. of Episodes
No Contacts	3.4	619
One or More	7.3	33
Total	3.6	652

$F = 17.2$, $p < .001$

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Resource Use by Physician Specialty at First Contact for Episodes of Obesity

Resource Use	Pct. of Episodes Int. Medicine	Pct. of Episodes Ob-Gyn	Pct. of Episodes Pediatric	Pct. of Episodes Other	Pct. All Episodes
No	60.3	56.1	77.1	67.0	61.8
Yes	39.7	43.9	22.9	33.0	38.2
Total	100.0 N=1367	100.0 N=107	100.0 N=144	100.0 N=88	100.0 N=1706

$X^2 = 18.1$, 3 df, $p < .001$

If yes, Resource Use

Mean Number of RVS Units/Episode by Physician Specialty at First Contact for Episodes of Obesity

	Mean No. of RVS Units./ Episodes	No. of Episodes
Int. Medicine	3.6	543
Ob-Gyn	3.0	47
Pediatric	4.2	33
Other	2.9	29
Total	3.6	652

$F = 0.5$, $p=.71$, $r = -.02$

Table 5-31

Resource Use by Year When Episodes of Obesity Began

Resource Use	Pct. of Episodes 1966	Pct. of Episodes 1967	Pct. of Episodes 1968	Pct. of Episodes 1969	Pct. of Episodes 1970	Pct. of Episodes 1971	Pct. of Episodes 1972	Pct. of Episodes 1973	Pct. No. Episodes
No	27.1	43.4	47.9	62.7	70.1	70.9	75.0	80.8	61.8
Yes	72.9	56.6	52.1	37.3	29.9	29.1	25.0	19.2	38.2
Total	100.0 N=70	100.0 N=302	100.0 N=211	100.0 N=249	100.0 N=254	100.0 N=206	100.0 N=200	100.0 N=214	100.0 N=1706

$X^2 = 158.6$, 7df., $p < .001$
CC = .29
Gamma = .40

If yes, Resource Use

Mean Number of RVS Units/Episode by Year When Episode of Obesity Began

	Mean No. of RVS Units/ Episode	No. of Episodes
1966	4.8	51
1967	3.9	171
1968	4.5	110
1969	2.7	93
1970	2.5	76
1971	3.1	60
1972	3.1	50
1973	3.0	41
Total	3.6	652

$F = 2.0$, $p = .05$, $r = .10$

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Resource Use by Length of Treatment Period

Resource Use	Pct. of One Contact	Pct. of Episodes 1-6 mos.	Pct. of Episodes 7-12 mos.	Pct. of Episodes 13-24 mos.	Pct. of Episodes 25-36 mos.	Pct. of Episodes 37-48 mos.	Pct. of Episodes 49-60 mos.	Pct. of Episodes 61-72 mos.	Pct. of Episodes Over 72 mos.	Pct. All Episodes
No	87.2	46.5	48.9	49.3	51.7	44.4	29.2	22.3	18.6	61.8
Yes	12.8	53.5	51.1	50.7	48.3	55.6	70.8	77.7	81.4	38.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	N=755	N=172	N=88	N=150	N=149	N=133	N=106	N=94	N=59	N=1706

When Yes is broken down into five categories reflecting Total RVS Units per episode, $x^2 = 547.7$, 40 df., $p < .001$, CC = .49, Gamma = .53, r = .44

If Yes, Resource Use

Mean Number of RVS Units/Episode by Length of Treatment Period

	Mean No of RVS Units/ Episode	No. of Episodes
One contact	2.5	97
1-6 mos	2.5	92
7-12 mos	2.8	45
13-24 mos	2.6	76
25-36 mos	2.9	72
37-48 mos	3.5	74
49-60 mos	3.6	75
61-72 mos	5.4	73
over 72 mos	8.2	48
Total	3.6	652

F = 7.6, $p < .001$, r = .24

Table 5-33
Resource Use by Status of Obesity at First Contact

Resource Use	Presenting	First Assoc.	Second Assoc.	Third Assoc.	Fourth to Eighth Assoc.	All
No	0*	67.2	70.8	75.7	75.0	61.8
Yes	100.0	32.8	29.2	24.3	25.0	38.2
Total	100.0 N=176	100.0 N=1044	100.0 N=315	100.0 N=111	100.0 N=60	100.0 N=1706

*Zero Frequency cell, chi square value not appropriate

Table 5-34
Resource Use by Status of Episode of Obesity at First Contact for Obesity

Resource Use	Pct. of Episodes Initial Visit for Obesity	Pct. of Episodes Continuing Visit for Obesity	Pct. All Episodes
No	66.0	42.1	61.8
Yes	34.0	57.9	38.2
Total	100.0 N = 1408	100.0 N = 294	100.0 N = 1706

$X^2 = 58.3$, 1 df., $p < .001$

CC = .19

If yes, Resource Use

Mean Number of RVS Units/Episode by Status of Episode at First Contact for Obesity

	Mean No. of RVS Units/Episode	No. of Episodes
Initial Visit	4.1	172
Continuing Visit	3.4	479
Total	3.6	652

F = 2.6, p = .11

Table 5-35
Resource Use by Type of Appointment at First Contact for Episodes of Obesity

Resource Use	Pct. of Episodes Regularly Scheduled	Pct. of Episodes Other Than Regularly Scheduled	Pct. All Episodes
No	64.1	42.7	61.8
Yes	35.9	57.3	38.2
Total	100.0 N = 1521	100.0 N = 185	100.0 N = 1706

$x^2 = 31.1$, 1 df., p=.001

CC = .14

If yes, Resource Use

Mean Number of RVS Units/Episode by Type of Appointment at First Contact for Episodes of

	Mean No. of RVS Units/Episode	No. of Episodes
Regularly Scheduled	3.5	546
Other Than Regularly Scheduled	3.6	106
Total	3.6	652

F = 0.3, p = .87

Table 5-36
Resource Use by Return Visit Requested at First Contact for Episodes of Obesity

Resource Use	Pct. of Episodes No Return Requested	Pct. of Episodes Yes, Return Requested	Pct. All Episodes
No	71.9	31.4	61.8
Yes	28.1	68.6	38.2
Total	100.0 N = 1279	100.0 N = 427	100.0 N = 1706

$X^2 = 221.2$, 1 df., $p < .001$

CC = .34

If yes, Resource Use

Mean Number of RVS Units/Episode by Return Visit Requested at First Contact for Episodes of Obesity

	Mean No. of RVS Units/Episode	No. of Episodes
No Return Requested	2.8	359
Yes, Return Requested	4.4	293
Total	3.6	652

$F = 14.6$, $p < .001$

Table 5-37
Factors Discriminating Non Resource Users from Resource Users During Episodes of Obesity

Variable	Standardized Discriminant Function Coefficients Duration One Contact	 Duration One Contact to 48 months	 Duration Longer Than 48 months
Being Male	.33*	.48*	.44*
Advancing Age	.51*	.07	.09
Comorbidities at First Contact	.48*	.75*	.44
Contacts During Episodes for Exams without Sickness	.62*	.33*	.09
Contacts During Episodes for Diabetes or Thyroid-Related Diseases	-.08	-.38	-.49
Contacts During Episodes for Mental or Emotional-Related Diseases	-.22	-.21	-.55*
Contacts During Episodes for Diseases of the Bones or Organs of Movement	.02	.24*	-.27
Contacts During Episodes for Heart-Related Diseases	.09*	.11	-.19
First Contact for Obesity with Internist	.68	.23	-.06
More Recent Episode	.03	.18	-.19
	Canonical $r^2 = .127$	Canonical $r^2 = .069$	Canonical $r^2 = .099$

*F ratio $p \leq .05$

Table 5-38
Variables Used in AID Analysis

Independent Variables

Utilization

1. No. of Laboratory Procedures in Episode

   (0, 1, 2 or more)

2. No. of Physician Contacts in Episode

   (1, 2, 3, 4 5, or more)

3. No. of Hospital Admissions in Episode

   (0, 1 or more)

4. No. of Telephone and/or Letter Contacts in Episode

   (0, 1, 2, or more)

5. No. of Initial DOVs in Episode

   (0, 1)

6. No. of Follow-up DOVs in Episode

   (0, 1, 2, 3 or more)

7. No. of Telephone Calls - Re: Drug Refill in Episode

   Conditions in Episode

   (0, 1, 2, or more)

8. No. of Laboratory Tests (Cholesterol) in Episode

   (0, 1 or more)

9. No. of Laboratory Tests (PBI) in Episode

   (0, 1 or more)

10. No. of Laboratory Tests (Glucose) in Episode

    (0, 1 or more)

11. No. of Laboratory Tests (T_3) in Episode

    (0, 1 or more)

12. No. of Laboratory Tests (T_4)

    (0, 1 or more)

Table 5-38 Continued

Patient, Provider, and Medical Care Process

1. Sex
2. Age Group at First Contact in Episode
   (0-14, 15-44, 45 and over)
3. Specialty of Provider at First Contact in Episode
   (Internal Medicine, other)
4. No. of Comorbidities at First Contact in Episode
   (0, 1, 2, 3, 4 or more)
5. Year of First Contact in Episode
   (1966-67, 1968-69, 1970-71, 1972-73)
6. No. of Contacts for Endocrine Diseases (Diabetes and Thyroid) in Episode
   (0, 1, 2 or more)
7. No. of Contacts for Medical Exams or Other Special Conditions in Episode
   (0, 1, 2, 3 or more)
8. No. of Contacts for Psychotic, Psychophysiologic, Psychoneurotic and Personality Disorders in Episode
   (0, 1, 2 or more)
9. No. of Contact for Diseases of the Bones or Organs of Movement in Episode
   (0, 1 or more)

FIGURE 5-1

AID analysis tree in which individual utilization measures are used to predict total RVS per episode of obesity for all cases. Squares contain number of cases (N), mean RVS ($\bar{Y}$), and S.D. for episodes in each group. Parentheses contain percent of variation in parent group explained by each split. Brackets contain cumulative variation in parent group explained by all prior splits. Large numbers indicate terminations of bundle pathways.

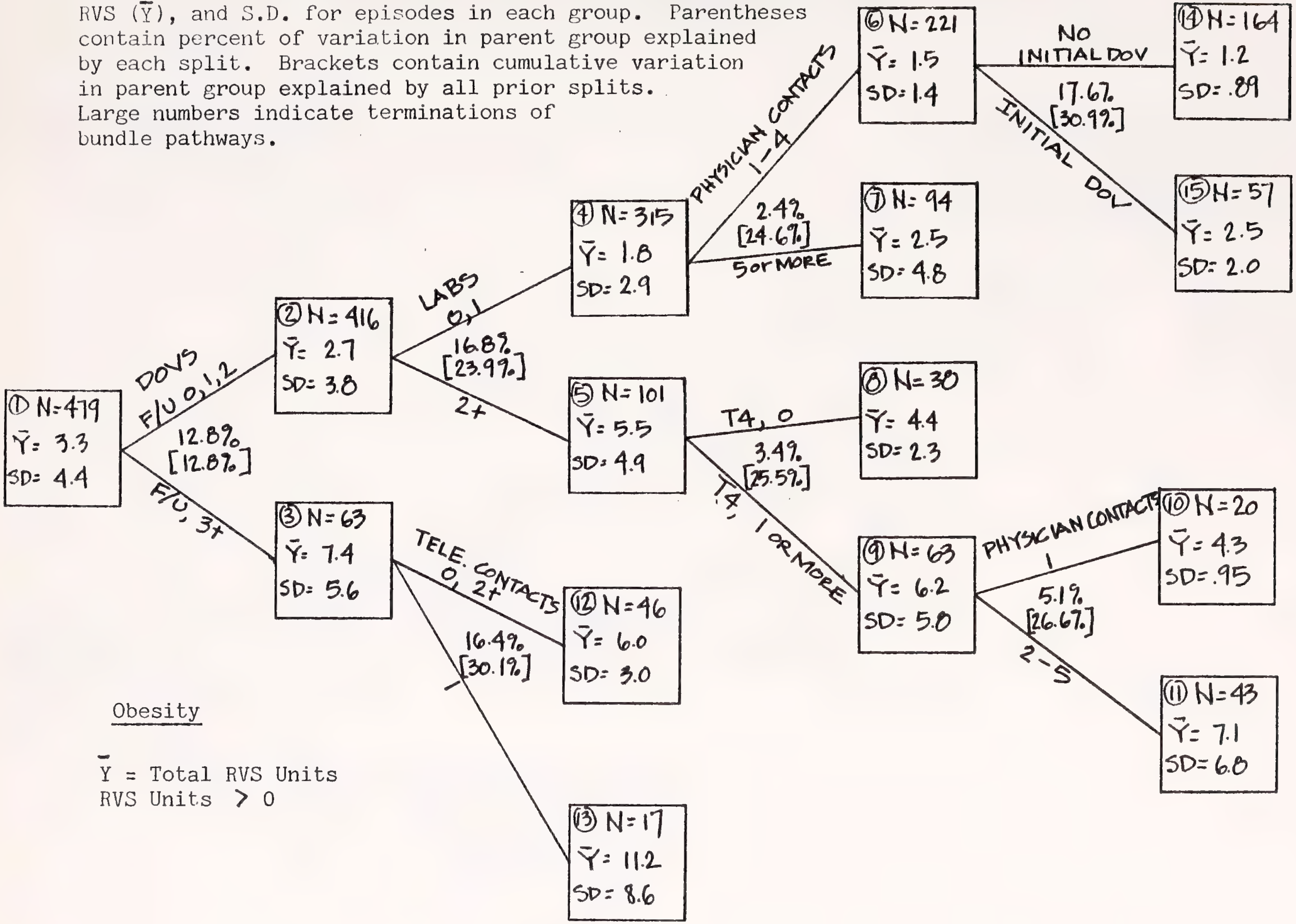


FIGURE 5-2

Utilization

Obesity

$\bar{Y}$ = RVS Units
Episodes < 1 Year
RVS Units > 0

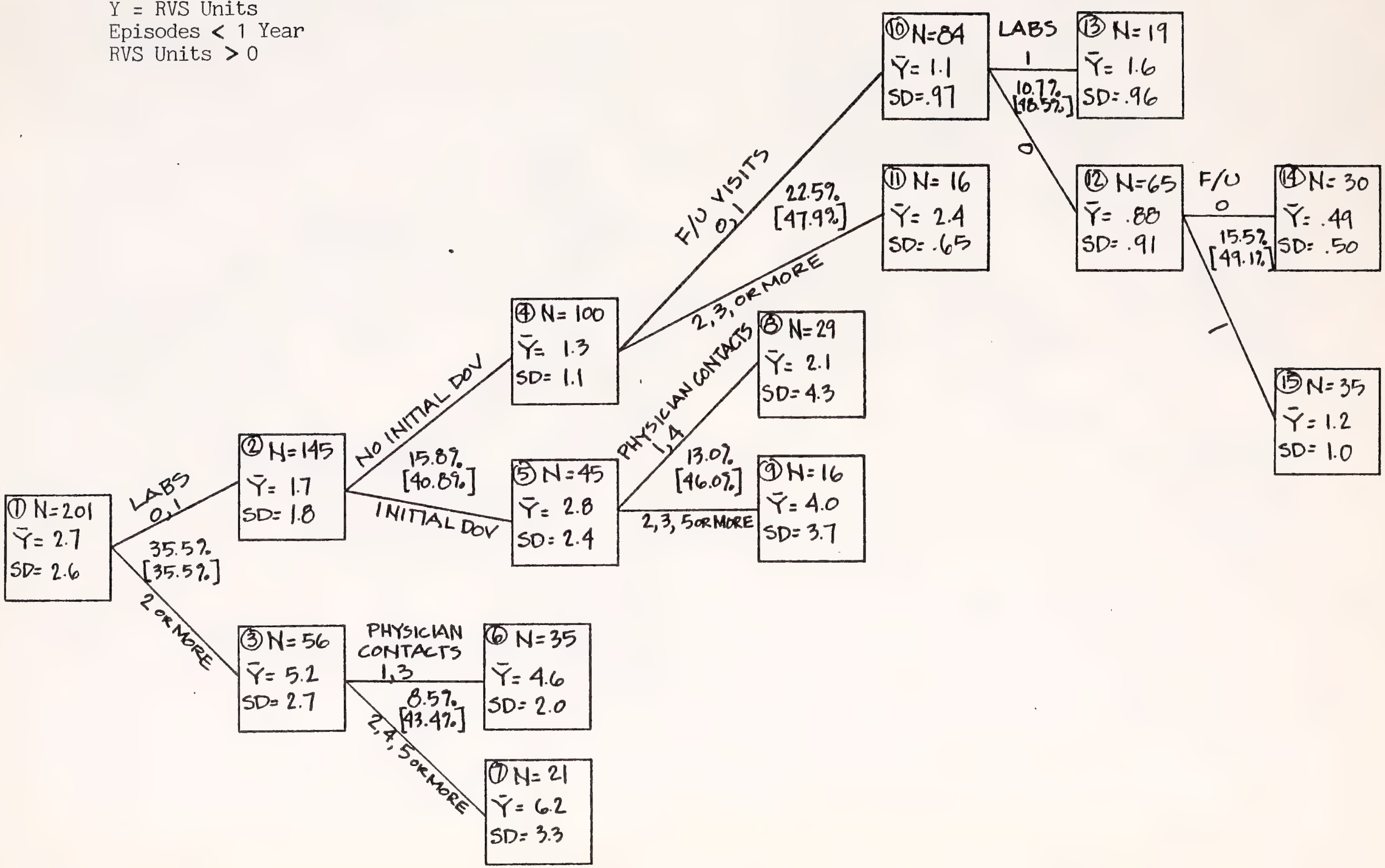

① N=201 $\bar{Y}$= 2.7 SD= 2.6
LABS 0,1
35.5% [35.5%]
2 OR MORE
② N=145 $\bar{Y}$= 1.7 SD= 1.8
③ N=56 $\bar{Y}$= 5.2 SD= 2.7
NO INITIAL DOV
15.8% [40.8%]
INITIAL DOV
PHYSICIAN CONTACTS 1,3
8.5% [43.4%]
2,4,5 OR MORE
④ N= 100 $\bar{Y}$= 1.3 SD= 1.1
⑤ N=45 $\bar{Y}$= 2.8 SD= 2.4
⑥ N=35 $\bar{Y}$= 4.6 SD= 2.0
⑦ N= 21 $\bar{Y}$= 6.2 SD= 3.3
F/U VISITS 0,1
22.5% [47.9%]
2,3, OR MORE
PHYSICIAN CONTACTS 1,4
13.0% [46.0%]
2,3, 5 OR MORE
⑧ N=29 $\bar{Y}$= 2.1 SD= 4.3
⑨ N=16 $\bar{Y}$= 4.0 SD= 3.7
⑩ N=84 $\bar{Y}$= 1.1 SD=.97
⑪ N= 16 $\bar{Y}$= 2.4 SD= .65
LABS 1
10.7% [48.5%]
0
⑫ N=65 $\bar{Y}$= .88 SD= .91
⑬ N= 19 $\bar{Y}$= 1.6 SD= .96
F/U 0
15.5% [49.1%]
1
⑭ N= 30 $\bar{Y}$= .49 SD= .50
⑮ N= 35 $\bar{Y}$= 1.2 SD= 1.0

FIGURE 5-3

Utilization

Obesity

$\bar{Y}$ = RVS Units/Month X 100
Episodes $\geq$ 1 Year
RVS/Month > 0

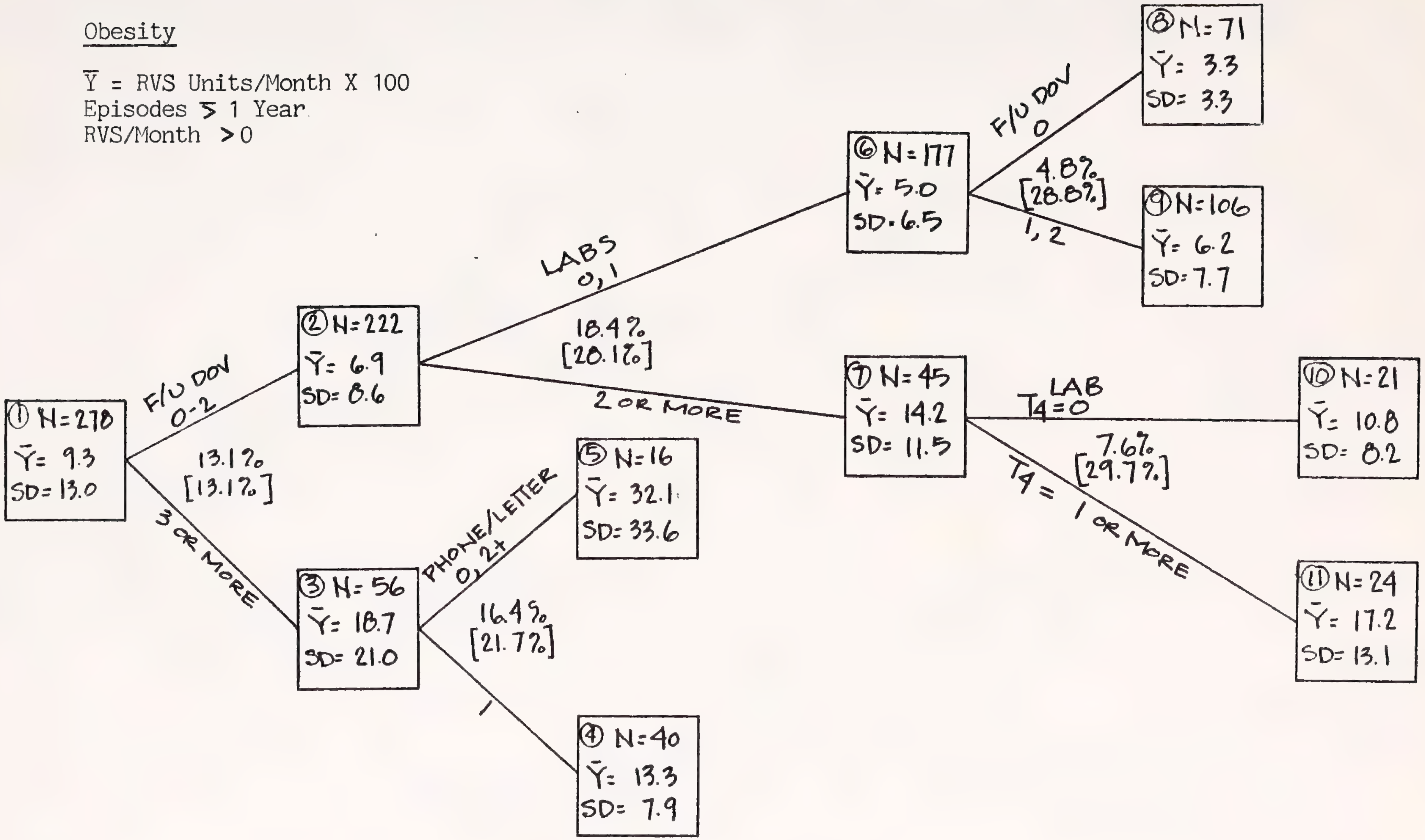
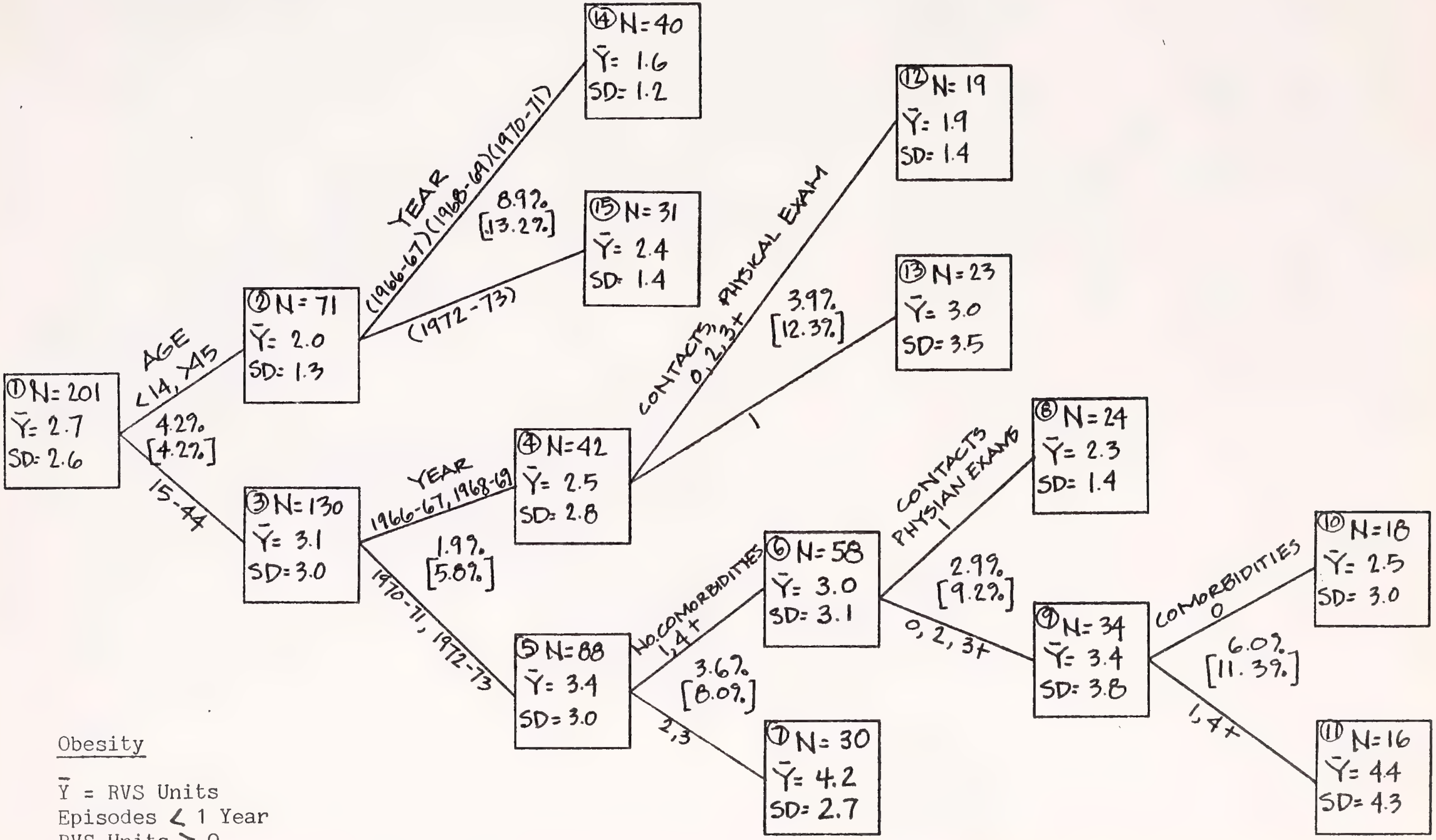


FIGURE 5-4

AID analysis tree in which patient, provider, and medical care process characteristics are used to predict total RVS per episode of obesity for all cases. Squares contain number of cases (N), mean RVS (Y), and S.D. for episodes in each group. Parentheses contain percent of variation in parent group expalined by split. Brackets contain cumulative variation among all cases explained by prior splits. Large Numbers identify terminations of pathways in order of increasing RVS charges.



Obesity

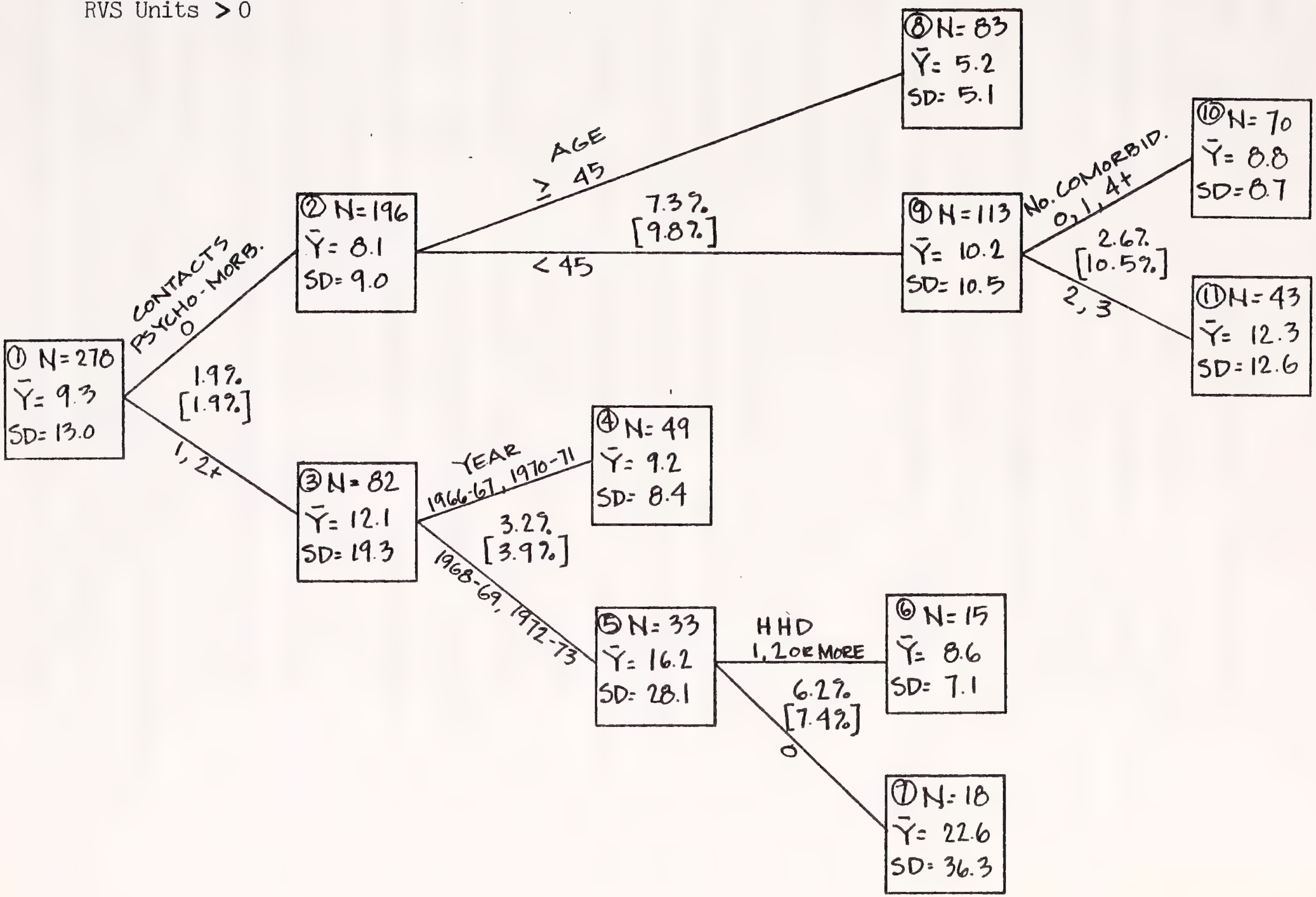
$\bar{Y}$ = RVS Units
Episodes < 1 Year
RVS Units > 0

FIGURE 5-5

Patient, Provider, Medical Care Process

Obesity

$\overline{Y}$ = RVS Units/Month X 100
Episodes $\geq$ 1 Year
RVS Units $>$ 0


① N=278 $\bar{Y}$= 9.3 SD= 13.0
CONTACTS PSYCHO-MORB.
0
1.9%
[1.9%]
1, 2+
② N=196 $\bar{Y}$= 8.1 SD= 9.0
③ N=82 $\bar{Y}$= 12.1 SD= 19.3
AGE
≥ 45
7.3%
[9.8%]
< 45
⑧ N=83 $\bar{Y}$= 5.2 SD= 5.1
⑨ N=113 $\bar{Y}$= 10.2 SD= 10.5
No. COMORBID.
0, 1, 4+
2.6%
[10.5%]
2, 3
⑩ N=70 $\bar{Y}$= 8.8 SD= 8.7
⑪ N=43 $\bar{Y}$= 12.3 SD= 12.6
YEAR
1966-67, 1970-71
3.2%
[3.9%]
1968-69, 1972-73
④ N=49 $\bar{Y}$= 9.2 SD= 8.4
⑤ N=33 $\bar{Y}$= 16.2 SD= 28.1
HHD
1, 2 OR MORE
6.2%
[7.4%]
0
⑥ N=15 $\bar{Y}$= 8.6 SD= 7.1
⑦ N=18 $\bar{Y}$= 22.6 SD= 36.3

SECTION VI. ACUTE CYSTITIS

Thomas M. Vogt

I. INTRODUCTION

Acute cystitis is a usually short-lived bacterial illness with a well-defined onset and generally straightforward diagnostic and treatment procedures. "Costs" of care are defined by modified California Relative Value Scale (RVS) units. This analysis involves the identification of major diagnostic and treatment bundles associated with acute cystitis and a delineation of differences in resource use associated with them.

II. EPISODE DEFINITION

For the purposes of this analysis, acute cystitis was defined according to the International Classification of Diseases, Adapted, 7th edition as codes 605.0 (acute cystitis) and 609.0 (acute urinary tract infection). These two codes were combined because in practice 609.0 is almost always the same entity as 605.0. These two rubrics were analyzed separately to assure that this assumption was justified, and there were no significant differences in treatment patterns or costs. Only episodes occurring in women were used in the analysis since the condition is far less common in men and is more likely to be associated with significant comorbid conditions in men.

Definition of an episode of cystitis - The episode began at the time of the first contact (by office visit, mail, telephone) where the specific diagnosis of acute cystitis

(ICDA, 7th edition, 605.0) or acute urinary tract infection (ICDA 609.0) was made or another diagnosis or symptom was indicated which was subsequently updated to acute cystitis. If two such diagnoses occurred within 60 days of each other they were considered a part of the same episode of illness. If they were more than 60 days apart, they were considered separate episodes unless there was specific information in the medical record linking the two contacts together. Episodes diagnosed as chronic recurrent cystitis (ICDA 605.3) were excluded from the analysis in order to maximize homogenity among cases. Thus, a new episode was initiated when there was no indication or mention of continuity and when sufficient time had elapsed since the last contact to justify considering a new contact as part of a new episode. A total of 1,371 episodes were identified between September, 1966 and December, 1973.

To ascertain possible confounding effects of co-morbidities on utilization measures for cystitis, the episodes were broken down into three subgroups according to the presence or absence of other coexisting conditions. Group 1 consisted of all episodes of cystitis in which there was a coexisting diagnosis of any chronic urinary tract condition. This group included persons with hydronephrosis (ICDA, 7th edition, 601), ureteral disease (603.6-603.9), calculi (602, 604), and bladder abcess (605.2, 605.3). There were 100 episodes in this group. No other chronic urinary tract conditions coexisted with cystitis in these episodes.

Group 2 consisted of 587 episodes coexistent with any other diagnosed morbidities unrelated to the urinary tract at the time of the episode of cystitis. Group 3 contained 684 episodes in which there were no morbidities other than acute cystitis.

Episodes with drug information involved smaller numbers since drug data were collected only during 1972 and 1973. Analysis of these data are limited due to the smaller sample sizes. Only 540 of the 1,371 episodes of acute cystitis occurred during these two years.

III. RESULTS

A. Demographic Description of the Population

Figures 6-1 through 6-4 show frequency distributions of the cystitis episodes by age, morbidity group assignment (1=other urinary tract comorbidities present, 2=other nonurinary tract comorbidities present, 3=no other comorbidities present), specialty of provider at first contact, and duration of episode. The age distribution was approximately normal, with the peak in the 24-44 year old age group. One-half the episodes involved no morbidities other than acute cystitis, 43 percent involved other non-urinary tract comorbidities, and 7 percent involved other urinary tract comorbidities. Fortysix percent of episodes involved only a single contact, and six percent lasted more than nine weeks.

B. Overview of Potential Confounding Variables

Because age and the presence of other morbidities might act as confounding variables in these analyses, separate

estimates of utilization by age and morbidity group were performed (Tables 6-1 through 6-4). These analyses indicate that utilization of resources in the treatment of cystitis is unrelated to age except in the pediatric age group, and also does not differ significantly between morbidity groups 2 and 3. Episodes with other urinary tract comorbidities (group 1) have significantly higher use of all RVS categories except letters.

Office visits are always coded to the primary morbidity. That is, if a woman arrives at a medical office for a hypertension-related visit and, incidentally, acute cystitis is found, the RVS units associated with the visit will be coded to the hypertension and not to the cystitis. Thus, persons with other morbidities may be more likely to have the cost of the office visit charged to another morbidity. All other procedures, on the other hand, are directly charged to the morbidity for which they were performed.

C. Resource Utilization

Mean RVS units by category - Tables 6-1, 6-2, and 6-3 give the mean number of RVS units in various utilization categories by morbidity group, age, and specialty of provider initiating care. Since letters generated few RVS units in episodes of care for cystitis, they are not considered in subsequent analyses. More RVS units were consumed by episodes with chronic urinary tract comorbidities than those without such comorbidities, and more services were required in

treating pediatric episodes. The lack of overlap in age of patients treated by pediatricians and other specialty groups makes it impossible to determine if this higher cost of care in children is due to arbitrary differences in practice between physican specialties or to universally recognized differences in resource utilization by pediatric and adult age groups.

Telephone calls accounted for only 3.8 percent of all RVS units even though 42.9 percent of all episodes had at least one telephone contact. Conversely, x-ray procedures were used in only 7 percent of episodes, but they acounted for almost 10 percent of all charges. Office procedures accounted for only 4.2 percent of total RVS units in an episode of care. However, persons with chronic urinary tract conditions and those who are treated by urologists--often the same persons--had considerably higher office procedure use than those who did not have such conditions.

First contact for care of acute cystitis was by telephone in 14.8 percent of episodes. Females over 65 years of age were somewhat more likely to use the telephone than others (Table 6-5), but the difference was not large.

Except for those with chronic urinary tract conditions and those treated by the urologist, laboratory studies constitute about half of the total RVS units coded to the episodes (Tables 6-4, 6-6). The excepted groups use proportionally fewer such services, although their absolute

value is about the same. Obstetrician/gynecologists, on the other hand, seemed to use fewer laboratory studies, and fewer resources in other areas as well. This might arise as a result of a difference in patient mix, but the data required to determine the reason for lower utilization by this specialty were not available.

Mean number of medical office contacts per episode - Table 6-8 examines the relationship between morbidity group, age, and the mean number of medical office contacts per episode. Persons without comorbidities have substantially fewer medical office contacts than those who have comorbidities, and children have more such contacts than adults. Those with urinary tract comorbidities, and children with urinary tract comorbidities have more contacts than any other group.

Other measures of utilization - Table 6-9 shows the percent of episodes containing a specified number of regularly scheduled contacts, physician contacts, walk-in contacts, contacts during medical office hours, laboratory tests, x-rays and follow-up visits. No regularly scheduled appointments were made in 77 percent of episodes, 57 percent involved a single contact with a provider, and 79 percent involved no follow-up visit. There were no laboratory tests in 15 percent and no x-rays in 96 percent of episodes.

Table 6-10 presents the percent of episodes in which other selected measures of utilization occurred. Urine cultures were obtained in 72.5 percent of episodes, and two or

more cultures in 20.3 percent. Two or more office visits occurred in 14.9 percent of episodes, and no office visit was coded to cystitis in 13.7 percent of episodes. Almost half (46 percent) of episodes involved only a single contact.

Table 6-11 indicates the relationships between morbidity group, age, specialty of provider, the likelihood that more than one office visit was involved, that no urine culture was taken, the percent of contacts during regular office hours, and the percent of contacts in the emergency room. Several differences were observed: 1) episodes with other morbidities were more likely to have multiple office visits than those without them; 2) episodes with chronic urinary tract comorbidities were less likely to be seen in the emergency room during the episode than those with non-urinary tract comorbidities, and those episodes were less likely to use the emergency room than are those with no comorbidities; 3) adolescents and young adults were less likely than other age groups to have multiple office visits and more likley to use the emergency room; 4) children were most likely to receive a urine culture, and the elderly were least likely to receive one; 5) pediatricians and urologists were involved with more multiple office visit episodes than other specialties; 6) obstetrician/gynecologists were involved with fewer multiple office visit episodes; and 7) new health practitioners were most likely to order a urine culture, and pediatricians were next most likely, while more than half of the episodes

initiated by obstetrician/gynecologists did not involve a urine culture.

Further examination of the above showed that high resource utilization was characteristic of children, episodes with chronic urinary tract comorbidities, and those treated by pediatricians. New health practitioners and pediatricians were most likely to culture persons with cystitis, and to perform other procedures for acute urinary tract infection. Adolescents and young adults were less likely to be seen during clinic hours and more likely to use emergency facilities, a finding which is almost certainly a reflection of the fact that they are less likely to have a regular physician and less likely to be familiar with the workings of the medical care system than are persons in other age groups.

Figure 6-5 provides a graphic illustration of the frequency of medical office, emergency and telephone/letter contacts in all episodes.

Laboratory studies - The three most common laboratory procedures used in diagnosing acute cystitis were urinalysis (76 percent of episodes), urine culture (70 percent of episodes), and antibiotic sensitivity testing (24 percent of episodes) (Table 6-12). Although not indicated in the table, urine cultures were performed on 98 percent of episodes in which a urinary tract comorbidity was also present. Table 6-12 also indicates the number of times these tests were

performed during the episodes. Figure 6-6 indicates the percent of cystitis episodes without comorbidities in which various numbers of all types of laboratory tests were given. There is some variation in the number of laboratory tests given per episode, two being the most common (35 percent of episodes) and none the next most common (23 percent).

Return visit scheduling - Figure 6-7 presents information on the frequency with which return visits are requested for the group without co-morbidites. About 77 percent of such episodes had a return to laboratory requested, about 28 percent were requested to return to the same physician, and three percent to return to x-ray.

Drug orders - Figure 6-8 indicates the relative frequency with which various anti-infectives were ordered, and the proportion of episodes in which different number of drugs were ordered. Sulfa was the most common type of drug ordered (about 65 percent of episodes), followed by urinary anesthetics (33 percent), tetracycline (15 percent), and ampicillin (10 percent). Most episodes (almost two-thirds) received only a single drug order and about 13 percent received no drug orders at all. The remainder received two or more. The percent of episodes in which no drug was ordered is similar to the percent in which no office visit was made (13.7 percent). These could represent telephone inquiries with classic symptoms, but for which the patient did not come in for examination.

D. Statistical Analyses

1. Product-moment correlations - Table 6-13 provides selected Pearson product-moment correlation coefficients between selected variables. The number of months in which an individual was a member of the Health Plan in the year of the index contact was not highly correlated with utilization measures, suggesting that eligibility did not measurably affect utilization. Eligibility at the index contact was not significantly related to utilization. Thus, eligiblity, which could affect estimates of resource use in more chronic conditions, did not appear to confound these results. The negative relationship between office visit RVS units and number of associated morbidities ($r = -.233$) is an artifact of coding the office visit to the primary morbidity.

Correlations of utilization measures with year in which services were delivered were low, suggesting that no substantial changes in total resources in treating cystitis occurred in a linear trend during the course of the study. It is important to emphasize that, as with regression analyses, the linear assumption may not be the appropriate model.

Other correlations were significant in expected directions. That is, utilization was higher with longer episodes, higher in younger age groups, and, except for office visit charges, not strongly related to the number of associated morbidities. There were modest, but significant inverse relationships between the use of urine cultures and date and

number of associated morbidities. The percent of contacts occurring during regular office hours was significantly and inversely related to the year in which services were offered, a finding which may reflect an increase in the availability of walk-in and emergency services.

1. Multiple regression

Number of contacts per episode - Table 6-14 uses various independent measures to predict the number of contacts in total episodes of care. The 14 predictors, which include age, provider specialty, type of first contact, year of service, eligibility, and whether or not the final diagnosis of acute cystitis was made at the first contact, explained 11 percent of the total variation in numbers of contacts. The most statistically significant predictor (diagnosis made at first contact) explained 1.6 percent of the variation and, as would be expected, was inversely related to number of contacts. Other significant predictors included age, pediatric physician at first contact, and use of telephone/letter for first contact.

Table 6-15 uses the same independent variables to predict total RVS units per episode. They explained only 7.4 percent of the total variation. Although seven of the predictors were significantly associated with the total RVS charges, only pediatric physicians at initial contact, Ob/Gyn physicians at initial contact, and age explained more than 1 percent of the variation.

The low proportion of variation explained is probably a product of two different factors. First, other predictors are certainly important. There is, for this first phase analysis, little detailed knowledge of patient condition. Second, the linear assumption of multiple regression may be an inappropriate model. The positive association of age to number of contacts is clearly the resultant vector of a higher number of contacts in the very young, followed by a gradually increasing number from adolesence through old age. Removal of the pediatric age group from the analysis could increase the percent of variation explained by age.

3. Automatic interaction detection (AID)

Two separate AID analyses were made for all episodes of cystitis and another two for the episodes without other comorbidities. The first breakdown was done with subcategories of utilization. That is, the total use of services is composed of separate components such as office visits, laboratory studies, and so forth. Pertinent subcategories of utilization (e.g., the number of urine cultures in the episode, number of office visit, etc.) were used to develop alternative "bundles" of care. Figure 6-9 indicates the utilization measures in all cystitis cases and the bundles of care which were associated with different diagnostic and treatment patterns.

For all cystitis episodes, four utilization variables explained 60.6 percent of the total variation in utilization.

These variables were: (1) the number of urine cultures (Ur cult), (2) the presence or absence of sensitivity tests (Sens), (3) the number of office visits (OV) in the episode, and (4) the presence or absence of x-rays (x-ray) in the episode of care. These four variables combined to produce 10 different bundles of care as indicated in the figure. The bundles are numbered from 1 to 10 in order of ascending cost. Mean RVS units per episode varied from 0.95 units per episode for bundle 1 to 22.44 units per episode for bundle 10.

Figure 6-10 shows the influence of patient, provider, and medical care process variables upon resource use in episodes of cystitis. Five variables significantly contribute to resource variation: (1) specialty of treating physician at first contact, (2) whether or not cystitis was a presenting morbidity at the first contact (as opposed to its discovery when another condition or no other condition was suspected), (3) presence or absence of other comorbidities, (4) year of service, and (5) type of appointment (explained below).

Since most models for explaining the utilization of health services using these types of variables usually succeed in explaining only 10-15 percent of the variation in utilization, it is surprising that these few variables explained as much as they did. Variables included in the analysis which failed to contribute to the explanation of variation in resource use were:

months effective in Health Plan
status of physician (regular or temporary attending)
number of associated morbidities
number of emergency room contacts in episode
presence of adverse drug effects in episode
pregnancy
age
whether or not the first contact was regularly scheduled
whether or not the first contact was a walk-in visit
time of first visit, regular hours or not

In an effort to separate out effects of comorbidities, a similar analysis was conducted on the 684 cystitis episodes that had no comorbidities. Figure 6-11 shows that three variables (number of urine cultures, presence or absence of sensitivity tests, and number of clinic visits in the episode) explained 56 percent of the total variation in RVS units. Six alternative bundles were identified. Figure 6-12 presents the analysis of patient, provider, and medical care process system predictors for this group. Five variables (type of appointment, physician specialty, year of service, presence or absence of walk-in visits, and age) explained 15.8 percent of the total variation.

These AID analyses indicated that the major sources of variation in the resources used to care for cystitis are the number of urine cultures performed, the number of office

visits, the presence of x-ray studies, and the use of sensitivity testing on positive urine cultures. The primary determinants of the use of these services were the specialty of the provider initiating care, whether or not cystitis was the presenting morbidity, the presence of other comorbidities and the type of appointment.

The potential importance of the type of appointment needs clarification. This item included information on whether the appointment was regularly scheduled, a walk-in, an emergency visit, a telephone call or letter, or other. Except for the relatively unimportant split on "walk-in" in the group without any comorbidities, all other splits on this variable occurred by separating "other" types of appointment from the other four categories. This "other" category was a large catch-all that included 46 different types of appointments such as dietician, cast room, back clinic, audiometry, alcohol treatment, administrative service, x-rays received from outside physician, etc. Many of these bear no relationship to cystitis and were never a part of a cystitis episode. Some of them, however, were relevant, and those which were relevant usually involve a smaller charge than a standard office visit. Thus, those who had "other" appointments in their episodes had mean costs lower than those who did not.

The above explanation is offered to avoid placing undue emphasis on this finding. The splits on year contributed little to the total amount of variation explained, and did

not occur in chronological order. Thus, it appears that the major predictor of resource use was the specialty of the attending provider, and this item seemed to be of more importance than the age of the patient.

IV. LOG LINEAR MULTIWAY CONTINGENCY MODEL

Using the bundles identified in the AID analyses, it is possible to identify the relative importance of two-factor and higher order interactions and test the fit of each given model to the data. The technique simultaneously adjusts for all other variables and their interactions while examining the relationship between two given variables.

Table 6-16 shows the 10 bundles of care identified when all episodes were included and the six bundles of care that were identified for episodes without comorbidities. These two sets of episodes were used in the log linear analyses. The bundles were treated as a single variable and the other variables were entered in an effort to determine which were associated with one or more of the bundles of care.

Models for all episodes - Table 6-17 lists all the relationships (log linear parameters divided by the standard error) of physician specialty and the occurence of cystitis as the presenting morbidity with the choice of bundles where $p \leq 0.10$. The table also provides beta values which are proportional to the relative risks associated with each of these relationships. Thus, according to Table 6-17, internists were more likely to use bundle 1 than were all

clinicians combined. In general, internists were more likely to select the less expensive bundles and less likely to have chosen the more expensive ones. Obstetricians/gynecologists were more likely to select bundle 1 (no culture, no office visit), but the numbers did not permit detection of any other significant associations. Pediatricians were most likely to treat cases with three or more cultures and three or more office visits. New health practictioners were least likely among providers to select bundle 1. This may be due to the fact that they are less likely to see persons with multiple morbidities, that they cannot order drugs without a physician counter-signature, and that they are more likely to treat and diagnose an illness according to a standard protocol.

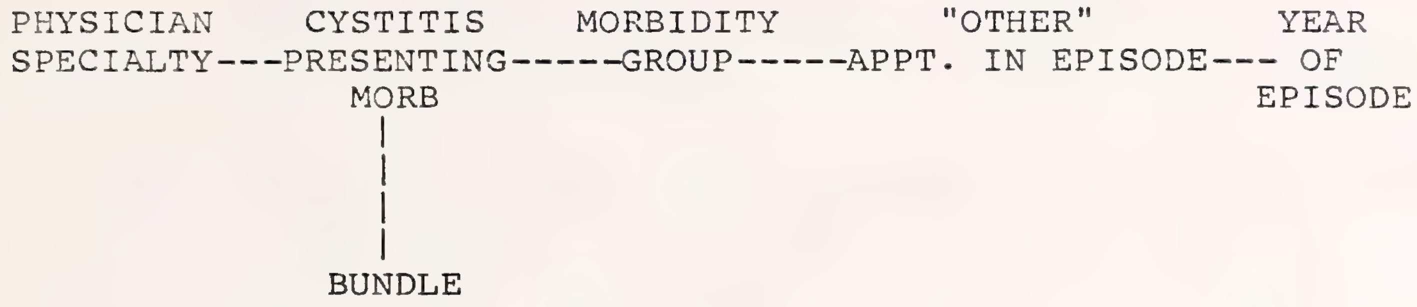
There were several significant two-way interactions between variables that were used to determine the bundle of care chosen. These are listed below with the log linear parameter/standard error, (beta value) and p values.

1. Episodes treated by obstetricians were less likely to have cystitis as the presenting morbidity than were episodes treated by other specialties, 2.30 (1.20), $p \leq .05$
2. Episodes with urinary tract comorbidities were less likely to be seen by internists, -3.50 (0.70), $p \leq .01$, and more likely to be seen by urologists, 3.54 (1.47), $p \leq .01$.

3. Episodes with non-urinary tract comorbidities were more likely to be seen by internists, 4.11 (1.45), $p \leq .01$, and less likely to be seen by urologists, -4.21 (0.63), $p \leq .01$.
4. Episodes seen by internists were less likely to involve "other" types of appointments as defined than were those seen by other providers, 3.59 (1.28), $p \leq .01$.
5. Episodes without comorbidities were more likely to have cystitis as the presenting morbidity, 6.84 (1.39) $p<.01$, while those with comorbidities were less likely to have cystitis as the presenting morbidity (1.85), $p \leq .01$, for both urinary and non-urinary tract comorbidities.

Significant three-way interactions occurred only between bundle, morbidity group, and whether or not the disease was presenting morbidity. These are indicated in Table 6-18. These three-way interactions indicated a relationship between bundle choice and the likelihood that bundles 1, 2, 5, 9, and 10 were chosen for morbidity groups 2 and 3. All such interactions were adjusted for when the final model was defined.

The Model for all Episodes - Diagrammed below is the pattern of interrelationships among all variables which determined the choice of treatment bundles. Only interactions significant at the $p \leq .05$ level are included.



The observed relationships between bundle and "other" appointments and cystitis as the presenting morbidity have been previously discussed. Year of episode is associated with bundle only indirectly through its direct relationship to the probability of an "other" type of appointment. As a result, the specialty of the physician at the initial contact is the only variable among these that is clearly related to the choice of bundle. Stated more simply, it suggests different physician specialties diagnose and treat acute cystitis in different ways when other factors and their interactions are adjusted.

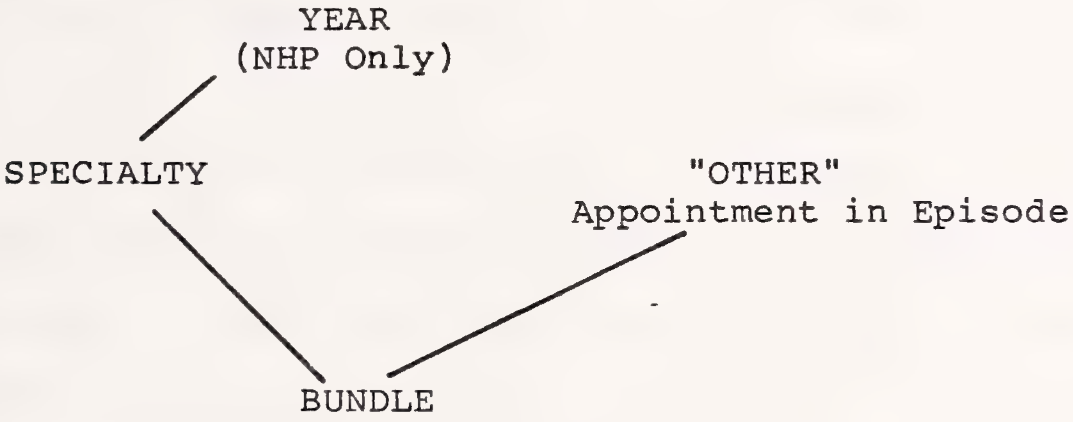
Model for Episodes Without Comorbidities - For these episodes the only significant interrelationships between bundle and physician specialty was the decreased likelihood that pediatricians would choose bundle 2, -2.30 (0.39), $p \leq .05$. Bundle two involved no urine cultures, one or more office visits, and no sensitivity tests.

Other significant two-way interactions for these episodes were:

1. New health practitioners (NHPs) were more likely to see patients in the last four years than in the first four years. This is no surprise since there were no NHPs in the system in 1966-1969, 1.98 (1.56) $p \leq .05$.

2. "Other" types of appointments were more likely to be a part of bundle 1, 6.74 (3.65) $p \leq .01$, and less likely to be a part of bundle 2, -2.35 (0.64), $p \leq .05$, and less likely to be a part of bundle 4, -1.95 (0.71), $p \leq .05$.

No other two-way and no three-way interactions were significant for this group. The final model developed for episodes without comorbidities is diagrammed below.



For these episodes only physician specialty (being a pediatrician versus not being a pediatrician) and "other" types of appointment was related to bundle choice. Again, the "other" appointments were significant primarily because of the way in which the coding was done.

E. Relation of Physician and Physician Specialty to Resource Use

Variation in resource use by physicians may derive from three sources. First, the differences may be due to different

patient groups. Pediatricians, for example, see patients of a different age mix than do internists and, if age is at all related to resource use, then differences between these specialty groups may be due to the respective ages of the patients they treat. Second, there may be alternative approaches to the same illness which are customary for a given specialty group, but not common to other specialties. New health practitioners, for example, are clearly more likely to use a urine culture to diagnose acute cystitis than are obstetricians, and the magnitude of this difference makes patient mix an unlikely cause, especially since the health practitioner is less likely to deal with complicated cases. Third, differences in resource use may be related to individual physician differences apart from their specialty designations. Such differences may be consistent from episode to episode for a given physician, or they may change according to a changing perspective of any given clinician.

Those differences of interest are alternative approaches to care which consume more or fewer resources than other medically acceptable alternatives and which are not a product of patient difference. The analysis of the data in this study is an exploration in this direction, but definitive answers could not be obtained from these data. These results are a first attempt to define between-specialty and within-physician variation for the care of episodes of cystitis.

There were not sufficient numbers of the various specialists to allow separate analyses for other than pediatricians (151 episodes) and internists (951 episodes). The physician of record was defined as the provider who saw the patient at the first contact in the episode. To further allow a separation of within- and between-physician variance, the analyses were limited to episodes in which a given physician had initiated care in 10 or more episodes. Ten pediatricians and 38 internists met this criterion.

Figure 6-13 presents the distribution of total RVS units among internists and pediatricians. The small number of pediatricians involved provided a rather non-normal distribution, but it was clear that pediatricians used more resources in caring for cystitis than did internists.

Figure 6-14 indicates the standard deviations of total RVS units among the two specialty groups. Pediatricians appeared to have larger standard deviations (i.e., there was a greater variation in resources used) than did internists. This is an important difference, although whether it can be ascribed to arbitrary patterns of care characteristic of the specialty or to the fact that cystitis in children is more often serious (i.e., more resource consuming) than in adults is not certain.

Table 6-19 examines the amount of variation in selected dependent variables which was explained by between-physician differences, that is, variation other than what is seen among

patients of a single physician. Predictably, a larger portion of the differences in care of those episodes without comorbidities (morbidity group 3) was explained by between-physician differences than for all episodes. Differences in patterns of care of cystitis patients without comorbidities were more likely to be due to physician preference than were differences in care for all cystitis patients, due to the greater differences in patient characteristics among the entire sample of cystitis episodes.

Table 6-20 examines this same issue for variations in resource use between and among pediatricians and internists who initiated 10 or more episodes. Pediatricians had more between-physician variation in number of contacts, laboratory services, telephone services, and total RVS units per episodes than did internists, but not more variation in number of office visits per episode. This suggests that pediatricians have a less standard approach to care for acute cystitis than do internists.

V. DISCUSSION AND CONCLUSIONS

The major findings of this analysis are:

1. More than 80 percent of the resources used in treating and diagnosing acute cystitis are accounted for by office visit and laboratory charges (excluding drug charges).
2. Mean RVS units per episode of care are relatively constant except for children and persons with other chronic urinary tract conditions, both of whom use more

resources than do others. Children with chronic urinary tract problems in addition to cystitis use about three times as many resources in receiving care for acute cystitis than do other groups.

3. Nearly 16 percent of episodes did not include any laboratory tests. Chart review will be required to determine if they were treated without laboratory procedures, or if these individuals were told to come in, but failed to appear.

4. Pediatricians used more resources and exhibited greater variation in treating cystitis than did other specialists. It was not possible from these data to determine if this was an effect of medical specialty (difference in training), or of age of patient or both. Current medical texts do not seem to differentiate in the recommendations for diagnostic and treatment procedures for acute cystitis between children and adults.

5. Obstetricians were least likely to culture patients before treating acute cystitis. New health practitioners were most likely to do so.

6. Urinalysis was performed at least once in 76 percent of episodes and urine culture in 73 percent.

7. About two-thirds of episodes received sulfa drugs, and one-third received a urinary anesthetic. Tetracycline and ampicillin were used less often.

8. Linear analysis using age, morbidity group, specialty of physician, and eligibility status of patient to predict total resource use explained about 10 percent of total variation in RVS units. This suggests that other variables are more important in explaining resource use, or that the appropriate models are not linear. Both factors probably play a role.
9. Between-physician variation accounted for about 20 percent of the variation in resource use. The remaining variation appears to be due to patient differences and changes in approach within individual physicians.
10. For all episodes, 10 bundles of care explained 62.3 percent of the total variation in resource use. The number of urine cultures was involved in four of the nine decision points within those bundles (see Figure 6-9). These groups ranged from a mean RVS of 0.95 units for the lowest users up to 22.44 RVS units for the highest users. Patient-provider-process characteristics significantly related to choice of bundle included specialty of treating physician, morbidity group, whether or not the condition was the presenting morbidity at the first contact, year of service, and the presence of "other" types of appointments in the episode.
11. Specialty of physician initiating diagnosis and treatment appeared to be substantively related to bundle choice.

The analyses suggest that there are several critical points in an episode of acute cystitis which help determine the level of resource use in diagnosing and treating the condition.

Of 1,371 episodes, 409 received no culture. These were the least expensive episodes. Whether or not cultures are a medically necessary approach to care is open to discussion. Episodes with a single culture were next lowest in resource use. These episodes probably represent a mix of those in which an initial culture was not followed by a repeat culture, those in which an initial urinalysis was accompanied by a culture, and those in which an initial urinalysis was followed by a culture after therapy was completed.

The magnitude of mean difference in resource use between the group with a single culture and the group which had two cultures, however, suggests that the former group had fewer office visits than those who had two cultures. This further suggests that an important decision point in determining resource use concerns the scheduling or non-scheduling of a follow-up visit after treatment. Since 79 percent of episodes did not include a routine follow-up visit, it is probably no coincidence that the group which was not cultured and the group that received a single culture total 79.5 percent of episodes.

Those episodes in which three or more cultures were done are clearly of a different sort. Mean resource use for this group is more than four-times greater than for those with two

or less cultures. This group undoubtedly includes treatment failures who required additional visits and therapy, as well as persons with complicating comorbidities.

A group with high resource use which constitutes 7 percent of the total number of episodes is identifiable because they received three or more urine cultures. The remaining 93 percent of the population appear to be best divided by the somewhat more arbitrary decisions surrounding the number of cultures and follow-up visits routinely selected in diagnosing and treating the condition. The assertion, contained in several texts, and reiterated by two medical consultants, that care for acute cystitis should include an initial culture and/or urinalysis followed by treatment which is followed in turn by a repeat culture, is clearly not followed in the majority of instances. Further studies would be required to determine if differential approaches result in different outcomes of care.

The AID analyses appeared to identify unique treatment bundles centered primarily around the use or non-use of initial and repeat urine cultures and the occurrance of follow-up visits after initial treatment. The cost of the least expensive approach is only about a quarter of the cost of the most expensive approach. Since cystitis is a relatively common condition, there are important cost implications for this difference. The degree to which the cost differentials are controllable through arbitrary

selection of less expensive pathways is less clear from this analysis, but might be readily examined given more detailed information. Pediatricians use more resources in treating cystitis. It is not clear, even after consultation with pediatricians and internists (both of which were included on the investigators panel) if this difference is based on sound clinical grounds or is simply a result of differences in routine, but untested standard clinical procedures of the different specialty groups. Similar remarks might be made about the low resource use by obstetricians and gynecologists in treating acute cystitis.

Interspecialty and interphysician variation are important predictors of resource use in cystitis. If these differences are not due to differences in "severity" of cystitis in the case mix of the various specialties, it would seem that some potential for cost modifications exists if the findings are further supported by more detailed analyses.

TABLE 6-1

Mean RVS Units per Episode (1 SD) of Cystitis for Selected Categories of Resource Utilization by Morbidity Group

	Morbidity Group			
	1	2	3	Mean
Telephone	.38(0.49)	.22(0.35)	.16(0.26)	0.20(0.32)
Office Visit	2.94(3.11)	1.97(2.52)	2.17(1.40)	2.15(2.11)
Laboratory Services	3.42(4.31)	2.69(3.40)	2.27(2.05)	2.53(2.89)
X-Ray Procedures	1.97(4.00)	0.55(2.10)	0.26(1.36)	0.51(2.00)
Letters	0.02(0.11)	0.01(0.08)	0.01(0.07)	0.01(0.08)
Office Procedures	1.11(2.98)	0.20(1.27)	0.11(0.99)	0.22(1.38)
Total RVS	8.89(9.77)	5.13(6.23)	4.74(3.58)	5.21(5.76)
N=	100	587	684	1371

Morbidity group 1 - coexisting urinary tract morbidities
Morbidity group 2 - coexisting non-urinary tract morbidities
Morbidity group 3 - no coexisting morbidities

TABLE 6-2

Mean RVS Units per Episode (1 SD) of Cystitis
for Selected Categories of Resource Utilization
by Age Group

	Age					
	0-14	15-24	25-44	45-64	65+	Mean
Telephone	0.35(0.48)	0.13(0.23)	0.16(0.25)	0.18(0.28)	0.32(0.41)	0.20(0.32)
Office Visit	2.91(3.01)	2.01(2.04)	2.03(1.74)	1.98(1.85)	1.92(1.97)	2.15(2.11)
Laboratory Services	3.72(3.76)	2.13(2.40)	2.37(2.88)	2.35(2.21)	2.38(3.13)	2.53(2.89)
X-Ray Procedures	1.35(3.19)	0.25(1.44)	0.35(1.67)	0.43(1.82)	0.42(2.04)	0.51(2.00)
Letters	0.03(0.16)	0.01(0.05)	0.01(0.05)	0.01(0.08)	0.00(0.03)	0.01(0.08)
Office Procedures	0.45(2.08)	0.09(0.80)	0.13(0.86)	0.29(1.56)	0.31(1.98)	0.22(1.38)
Total RVS	7.93(8.72)	4.34(4.72)	4.76(4.91)	4.86(4.54)	4.92(5.23)	5.21(5.76)
N =	217	276	501	258	119	1371

TABLE 6-3

Mean RVS Units per Episode (1 SD) of Cystitis
for Selected Categories of Resource Utilization
by Specialty of Provider at First Contact

	Specialty					
	Int	Ob/Gyn	Ped	Urol	NHP	Mean
Telephone	0.19(0.28)	0.16(0.29)	0.35(0.49)	0.23(0.28)	0.13(0.22)	0.20(0.32)
Office Visits	2.11(1.89)	1.15(1.53)	2.99(3.05)	2.14(1.88)	2.14(1.88)	2.15(2.11)
Laboratory Services	2.35(2.67)	1.54(2.15)	3.92(3.86)	2.20(2.82)	3.36(2.65)	2.53(2.89)
X-Ray Procedures	0.38(1.82)	0.10(0.85)	1.33(3.14)	0.72(2.36)	0.56(2.00)	0.51(2.00)
Letters	0.01(0.04)	0.01(0.05)	0.03(0.16)	0.02(0.10)	0.02(0.14)	0.01(0.08)
Office Procedures	0.10(0.85)	0.17(1.41)	0.33(1.78)	1.58(3.46)	0.23(1.11)	0.22(1.38)
Total RVS	4.80(4.98)	2.98(3.64)	8.08(8.67)	6.23(6.27)	6.41(5.03)	5.21(5.76)
N =	856	136	201	72	54	1371

TABLE 6-4

Mean Percent of Total RVS Units per Episode of Cystitis Attributable to Different Utilization Categories by Morbidity Group

Percent of Total RVS Due To	Morbidity Group 1	2	3	Mean
Telephone	9.3	4.3	3.4	3.8
Office Visit	33.1	38.4	45.0	41.3
Laboratory	38.5	52.4	47.9	48.6
Office Procedures	12.5	3.9	2.3	4.2
X-Ray	22.2	10.7	5.5	9.8

TABLE 6-5

Mean Percent of Total RVS Units per Episode of Cystitis Attributable to Different Utilization Categories by Age

Percent of Total RVS Units Due to Age	Age					
	0-14	15-24	25-44	45-64	65+	Mean
Telephone	4.4	3.0	3.4	3.7	6.5	3.8
Office Visit	36.7	46.3	42.6	40.7	39.0	41.3
Laboratory	46.9	49.1	49.8	48.4	48.4	48.6
Office Procedure	5.7	1.9	2.7	6.0	6.3	4.2
X-Ray	17.0	5.8	7.4	8.4	8.7	9.8

TABLE 6-6

Mean Percent of Total RVS Units per Episode of Cystitis Attributable to Different Utilization Categories by Specialty of Provider at First Contact

Percent of Total RVS Units Due to Age	Specialty					
	Int	Ob/Gyn	Peds	Urol	NHP	Mean
Telephone	3.9	5.4	4.3	3.7	2.0	3.8
Office Visit	44.0	38.6	37.0	34.3	37.6	41.3
Laboratory	49.0	51.7	48.5	35.1	52.4	48.6
Office Procedure	2.1	5.7	4.1	25.4	3.6	4.2
X-Ray	7.9	3.4	16.5	11.6	8.7	9.8

TABLE 6-7

Mean RVS Units per Episode of Cystitis by Age and Morbidity Group. Values are Given ± 2 SE

Age	Morbidity Group 1	2	3	Grand Mean
0-14	16.38 ± 4.96	6.93 ± 1.79	6.63 ± 1.19	7.93 ± 1.18
15-24	5.20 ± 5.19	4.09 ± 1.33	4.48 ± 0.69	4.34 ± 0.57
25-44	6.68 ± 2.73	5.19 ± 0.94	4.29 ± 0.36	4.76 ± 0.44
45-64	4.85 ± 2.50	4.97 ± 0.93	4.74 ± 0.62	4.86 ± 0.57
65+	7.63 ± 3.78	4.32 ± 1.11	4.39 ± 1.10	4.92 ± 0.96

Morbidity group 1 - coexisting urinary tract morbidities
Morbidity group 2 - coexisting non-urinary tract morbidities
Morbidity group 3 - no coexisting morbidities

TABLE 6-8

Mean Number of Medical Office Contacts (± 2 SE) per Episode of Cystitis by Age and Morbidity Group

Age	Morbidity Group		
	1	2	3
0-14	2.89 ± 0.63	1.96 ± 0.35	1.22 ± 0.19
15-24	1.20 ± 1.16	1.47 ± 0.29	0.83 ± 0.10
25-44	1.96 ± 0.54	1.52 ± 0.08	0.87 ± 0.08
45-64	1.54 ± 0.57	1.70 ± 0.21	1.00 ± 0.15
65+	2.00 ± 0.57	1.48 ± 0.23	0.94 ± 0.22
Mean	2.07 ± 0.29	1.61 ± 0.11	0.93 ± 0.06

TABLE 6-9

Percent of Episodes of Cystitis Containing the Indicated Number of Various Utilization Measures

Number	Reg. Sched. Contacts	Physician Contacts	Contacts During Clinic Hours	Walk-in Contacts	Laboratory Tests	X-Rays	Follow-Up Visits
0	76.9	4.2	11.0	38.7	15.1	95.9	79.2
1	19.3	56.7	56.7	57.5	11.7	3.7	17.8
2	3.4	24.3	20.2	3.2	32.7	0.4	1.9
3(+)	0.4	8.0	7.0	0.6	20.3	NA	1.0
4	NA	3.8	3.2	NA	9.4	NA	--
5(+)	NA	2.9	1.9	NA	5.0	NA	--
6	NA	--	--	NA	2.0	NA	--
7(+)	NA	--	--	NA	3.8	NA	--

NA=Not applicable. Dash included in last summary category (e.g., 3+ includes 4-7)

TABLE 6-10

Percent of Episodes of Cystitis Receiving Selected Utilization Measures

≥ 1 X-Ray	5.7
≥ 1 Urine Culture	70.8
≥ 2 Urine Cultures	20.3
1st Contact - Regularly Scheduled	26.0
1st Contact - Walk-In	44.9
1st Contact - Phone/Letter	14.8
≥ 1 Emergency Contacts	14.4
0 Medical Office Contacts	18.0
0 MD Contacts	3.2
1st Contact - Emergency	13.9
≥ 2 Office Visits	14.9
1 Contact in Total Episode includes telephone, letter, and office contacts)	46.0
0 Office Visit RVS Units	13.7
0 Telephone RVS Units	57.1
0 Letter RVS Units	97.6
0 X-Ray RVS Units	93.0

TABLE 6-11

Percent of Episodes of Cystitis Receiving Selected Utilization Measures by Morbidity Group, Age and Specialty of Physician at First Contact

	Morb. Group			Age					Specialty				
	1	2	3	0-14	15-24	25-44	45-64	65+	Int	Ob/Gyn	Ped	Urol	NHP
% $\geq$ 2 OVs	56.0	40.7	14.9	42.4	18.8	24.2	34.1	37.0	26.1	24.3	43.8	37.5	27.8
% No Urine Culture	--	--	--	18.0	31.5	31.3	30.6	39.5	29.8	54.4	16.4	34.7	9.3
% Contacts During Office Hours	92.7	87.2	83.9	87.6	78.6	86.9	88.5	90.4	86.2	86.1	86.9	95.5	91.1
% Contact in Emergency Room	2.5	7.5	12.0	8.0	15.5	9.6	6.4	3.0	9.6	5.8	8.8	0.5	2.5

TABLE 6-12

Number of Episodes of Cystitis in which Selected Laboratory Tests were Performed the Indicated Number of Times

		Number of Episodes						Number of Episodes (percent) Receiving $\geq$ 1 Test
		1	2	3	4	5	6^+	
TEST	Urinalysis	703	232	62	27	9	9	1044 (76.1)
	Urine Culture	682	182	50	27	10	9	970 (70.8)
	Sensitivity	292	31	5	3	1	2	334 (24.4)

TABLE 6-13

Pearson Product-Moment Correlation Coefficients between Selected Variables
in Episodes of Cystitis

	Total RVS	Lab RVS	X-Ray RVS	Phone RVS	Age	Duration	OVS RVS	# Cont/ Epis.	# Ass. Morb.	Mos. HP Eff.	Year	% Cont. Clin.Hrs.	Urine Cult.Done
Total RVS	1.0	.836***	.708***	.454***	-.108***	.687***	.780***	.725***	-.092***	.002	-.035	.041	.770***
Lab RVS		1.0	.373***	.416***	-.096***	.562***	.565***	.617***	-.054*	.031	.056	-.008	.853***
X-Ray RVS			1.0	.267***	-.088***	.452***	.430***	.440***	.052*	-.014	-.068	.072**	.375***
Telephone RVS				1.0	-.008	.592***	.288***	.793***	-.000	.051*	-.045*	.006	.432***
Age					1.0	-.02	-.119***	-.045*	.195***	.115***	-.075*	.070**	-.121***
Duration						1.0	.595***	.842***	.060*	.035	-.072	.088***	.598***
OV RVS							1.0	.655***	-.233***	-.002	-.071**	.052*	.604***
No. of Cont/Epis.								1.0	.067**	.031	-.063**	.046*	.642***
No. of Assoc. Morb.									1.0	.021	-.003	.028	-.084***
No. of Mos. HP Eff.										1.0	.091***	.008	.048*
Year											1.0	-.162***	.115***
Pct. Cont. Clin. Hrs.												1.0	.022
Urine Cult. Done													1.0

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* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$

TABLE 6-14

Multiple Regression Using 14 Variables to Predict the Number of Contacts per Episode of Cystitis

Dependent Variable - Number of Contacts in Episode

Independent Variables	Beta	F	R2
1. Age	.079	5.69*	.002
2. Internist	.309	0.18	.010
3, Ob/gyn	-.027	0.25	.012
4. Pediatrics	.279	19.59*	.037
5. Urology	.046	1.04	.002
6. NHP	.034	0.71	.000
7. Surgery	-.011	0.14	.000
8. Telephone/letter, 1st contact	.150	5.80*	.013
9. Emergency visit, 1st contact	.015	0.07	.001
10. Reg. Sched., 1st contact	.070	0.93	.010
11. Walk-in, 1st contact	.029	0.11	.001
12. Mos. Eff. in Health Plan	.012	0.21	.000
13, Year of first contact	-.050	3.44	.001
14. Cystitis Dx'd at 1st contact	-.149	23.67*	.016
		Cum. R^2 =	.107

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*p $\leq$ .05

TABLE 6-15

Regression Analysis Using 14 Predictor Variables to Estimate Total RVS

Dependent Variable - Total RVS Units/Episode

Independent Variables	Beta	F	R^2
1. Age	.034	1.30*	.012
2. Internist	.009	0.01	.002
3, Ob/gyn	-.065	1.37	.030
4. Pediatrics	.239	13.91*	.011
5. Urology	.062	1.87	.001
6. NHP	.064	2.40	.003
7. Surgery	-.009	0.94	.000
8. Telephone/letter, 1st contact	.119	3.54*	.001
9. Emergency visit, 1st contact	.143	5.62*	.000
10. Reg. Sched., 1st contact	.222	9.07*	.000
11. Walk-in, 1st contact	.231	7.11*	.008
12. Mos. Eff. in Health Plan	.203	0.01	.000
13, Year of first contact	-.048	3.08*	.002
14. Cystitis Dx'd at 1st contact	.066	4.55*	.003
		Cum. R^2 =	.074

Note: The use of Age^2 and Age x Morb. -group do not add information to the above regression.

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*$p \leq .05$

TABLE 6-16

Bundles of Care as Identified by AID Analysis in Episodes of Cystitis

Bundle	N	Mean RVS	S.D.
1. 0 ur cult, 0-1 OV, 0 sens, x-ray	346	0.95	1.28
2. 1 ur cult, 0 sens, 0 x-ray	473	3.23	1.90
3. 0 ur cult, 2+ OV, 0 sens, 0 x-ray	46	3.46	4.24
4. 2 ur cult, 0 sens, 0 x-ray	107	5.77	2.19
5. 1 ur cult, 1+ sens	200	6.26	1.90
6. 0 or 2 ur cult, 1+ sens	76	9.22	4.14
7. 3+ ur cult, 0 sens, 1+ x-ray	28	11.36	5.53
8. 0-2 ur cult, 0 sens, 1+ x-ray	25	13.04	7.72
9. 3+ ur cult, 3+ OV, 0 sens	31	16.97	7.66
10. 3+ ur cult, 3+ OV, 1+ sens	39	22.44	13.55
	1371		
Cases with no existing comorbidities			
1. 0 ur cult, 0 OV, 0 sens	90	0.47	0.88
2. 0 ur cult, 1+ OV, 0 sens	96	2.55	1.98
3. 1 ur cult, 0 sens	267	3.49	1.47
4. 0-1 ur cult, 1+ sens	126	6.55	1.94
5. 2+ ur cult, 0-1 OV	46	7.28	2.56
6. 2+ ur cult, 2+ OV	59	10.27	5.94
	684		

ur cult - urine culture, sens. - antibiotic sensitivity test,
OV - office visits, x-ray - number of x-rays

TABLE 6-17

Log Linear Parameters Divided by Their Standard Errors (Beta Values) for All Relationships with $p \leq 0.1$ in Episodes of Cystitis

Bundle	Int	ObGyn	Ped	Urol	NHP	Cyst Presenting
1	4.04**(1.90)	3.23**(1.82)			-296**(0.50)	
2	2.98**(1.71)					-2.55**(0.79)
3			-1.88+(0.63)			1.79+(1.21)
4						
5	2.45**(1.63)					
6						
7	-1.75+(0.67)					
8	-2.86**(0.52)			3.58*(2.17)		
9	-1.80+(0.67)		1.69+(1.45)			
10	-1.89+(0.66)		2.07*(1.58)			

+-$p \leq 0.1$

*-$p \leq 0.05$

**$p \leq 0.01$

TABLE 6-18

Significant 3-Way Interactions Between Log Linear Variables in Episodes of Cystitis

Treament Bundle	Morbidity Group	Cystitis Presenting Morbidity	beta
1	2	-3.64**	(0.64)
	3	4.47**	(1.77)
2	2	-2.55**	(0.72)
	3	3.59**	(1.62)
5	3	2.27**	(1.37)
9	3	-2.63**	(0.67)
10	2	2.19*	(1.37)
	3	-2.42*	(0.70)

$*p \leq .05$

$**p \leq .01$

TABLE 6-19

Percent of Variance Explained by Between-Physician Differences for Morbidity Group 3 (No Co-morbidities) and All Episodes of Cystitis Combined

	No Co-Morbidities	All Episodes
	Within Group VAR=ETA^2	Within Group VAR=ETA^2
Total RVS Units	.165	.126
Duration	.113	.093
No. of Contacts in Episode	.200	.127
1+ Urine Culture	.153	.122
2+ Urine Culture	.189	.010
Telephone RVS Units	.214	.136
Letter RVS Units	.167	.080
No. of Office Visits	.198	.130

TABLE 6-20

Proportion of Total Variance Explained by Between-Physician Variation in Selected Utilization Measures. Includes Only Physicians Who Treated $\geq$ 10 Episodes of Cystitis.

	Internists (n=38)	Pediatricians (n=10)	Other (n=11)
	ETA^2	ETA^2	ETA^2
No. of Contacts/ Episode	.059	.122	.054
No. of Clinic Contacts/Episode	.114	.114	.081
Lab RVS Units/ Episode	.074	.109	.136
Telephone RVS Units/ Episode	.074	.156	.065
Total RVS Units/ Episode	.060	.129	.129
Duration of Episode	.065	.082	.060

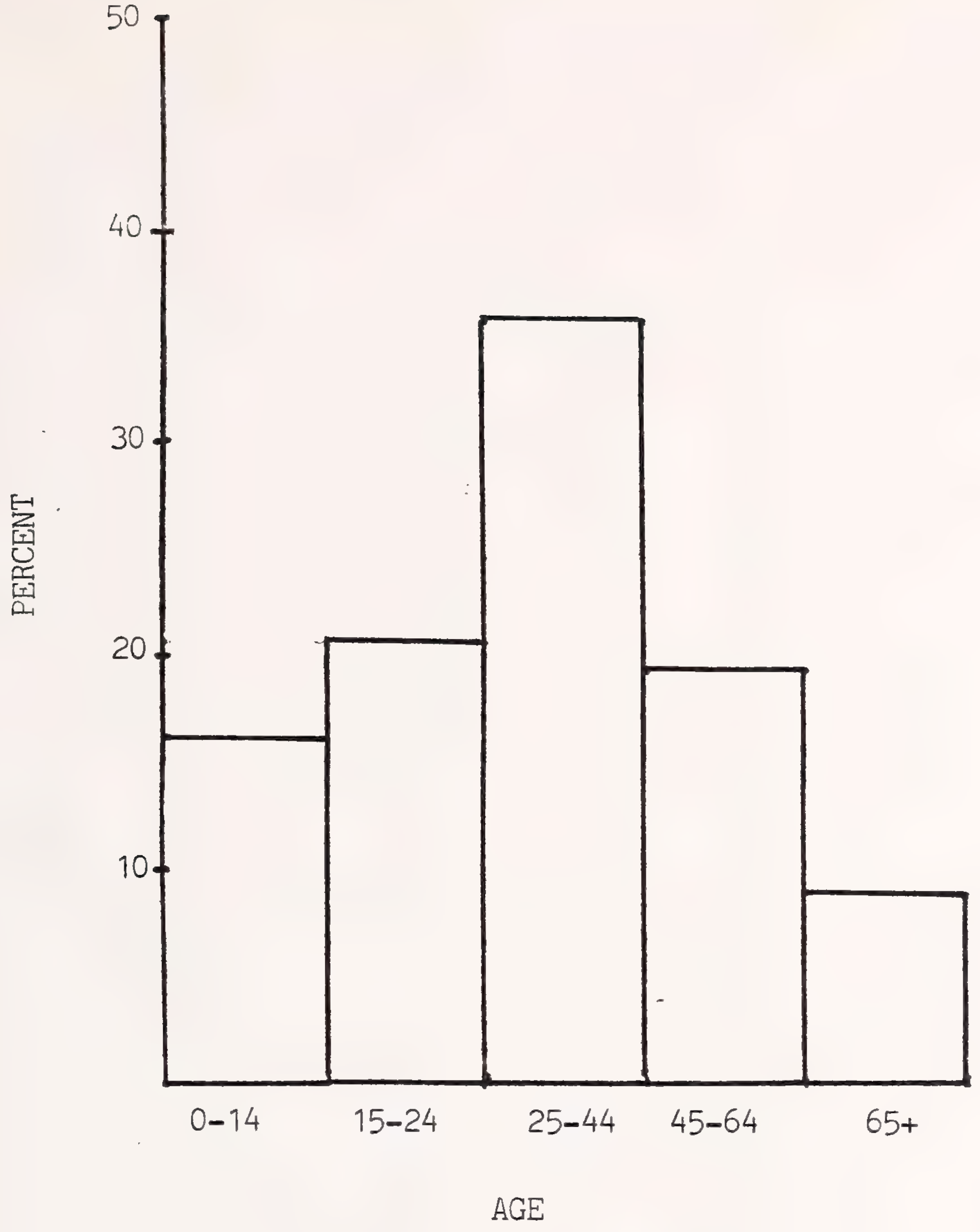


FIGURE 6-1

Age Distribution of Cystitis Episodes

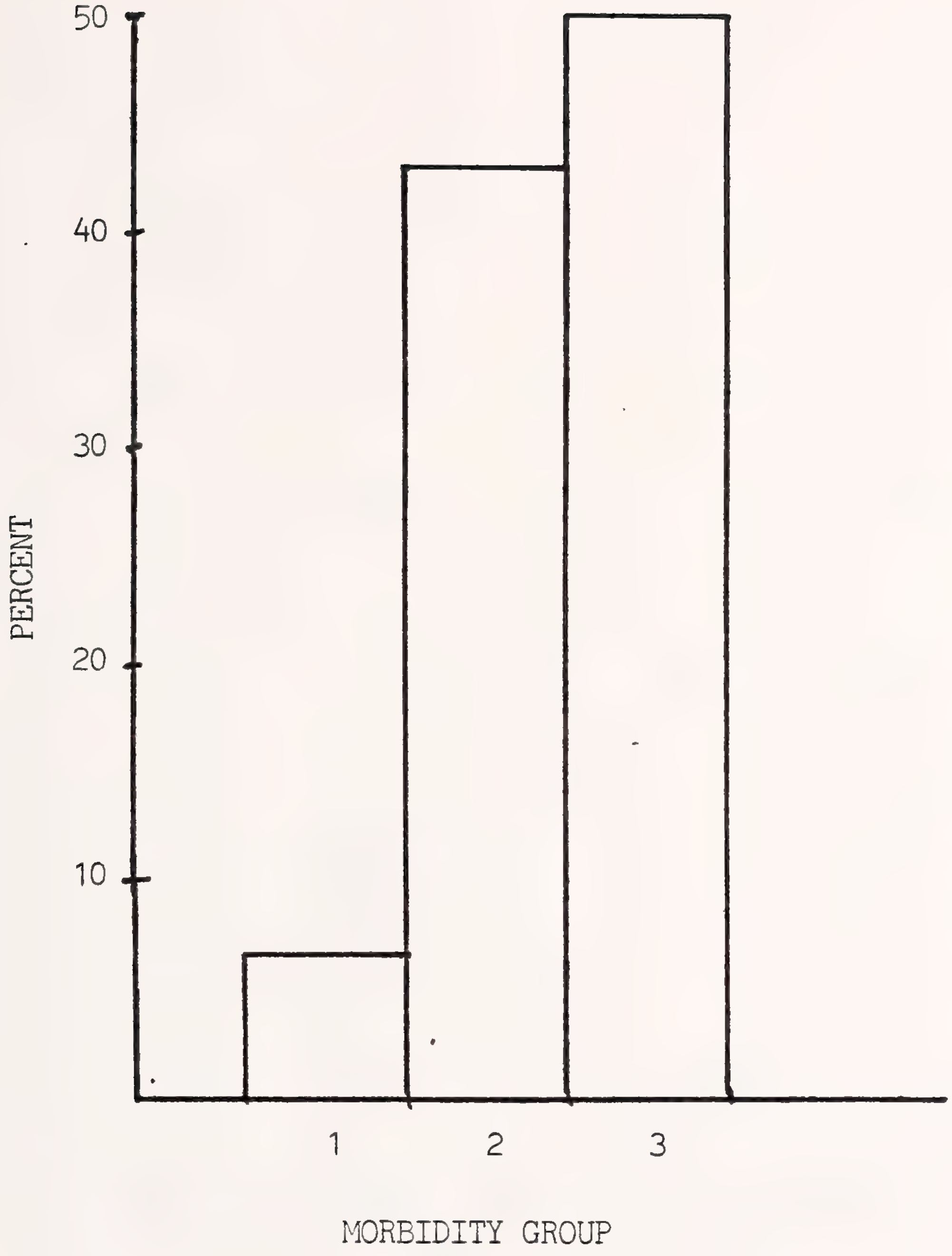
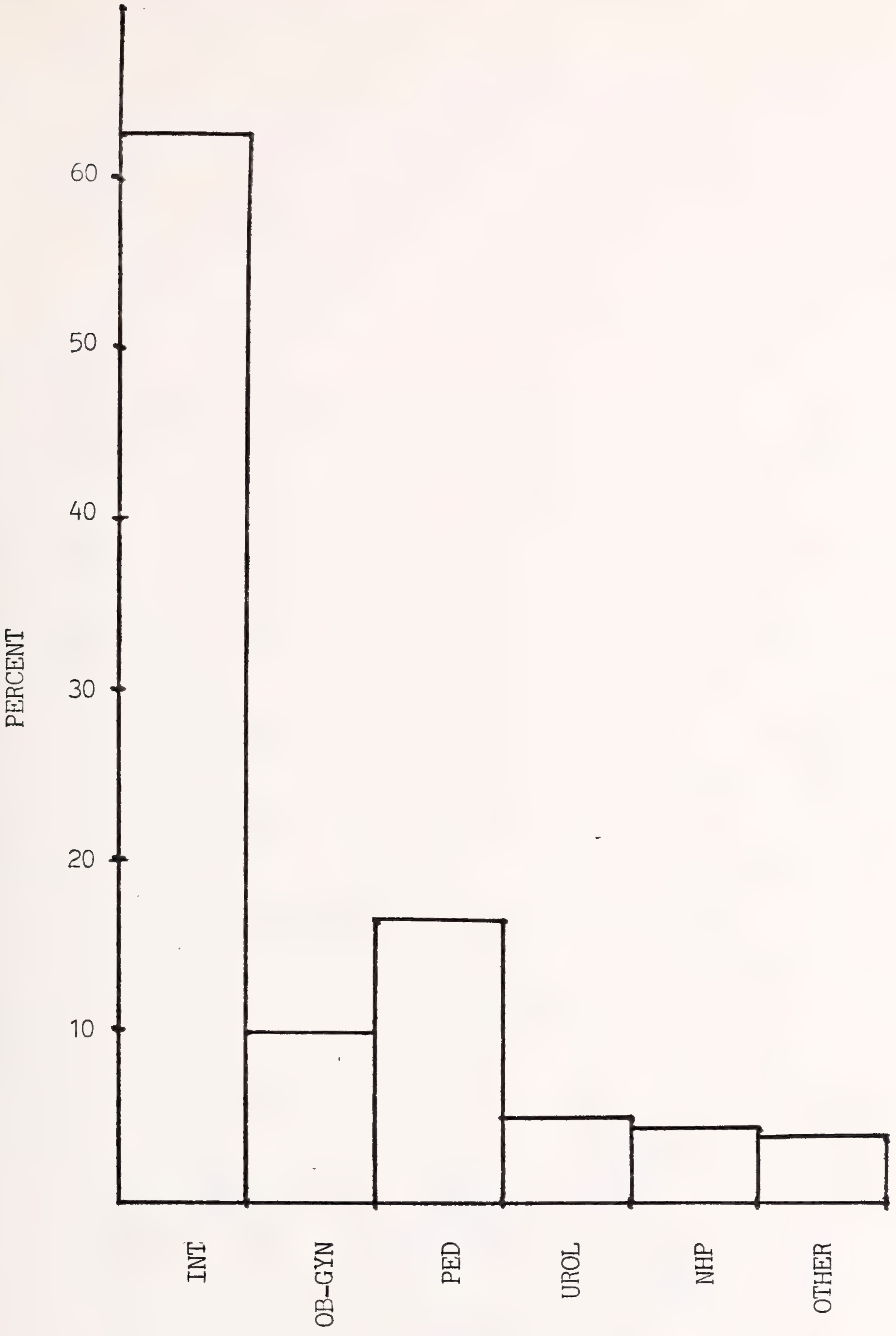


FIGURE 6-2

Distribution of Cystitis Episodes by Morbidity Groups



SPECIALTY OF PROVIDER AT FIRST CONTACT

FIGURE 6-3

Distribution of Cystitis Episodes by
Specialty of Provider at First Contact

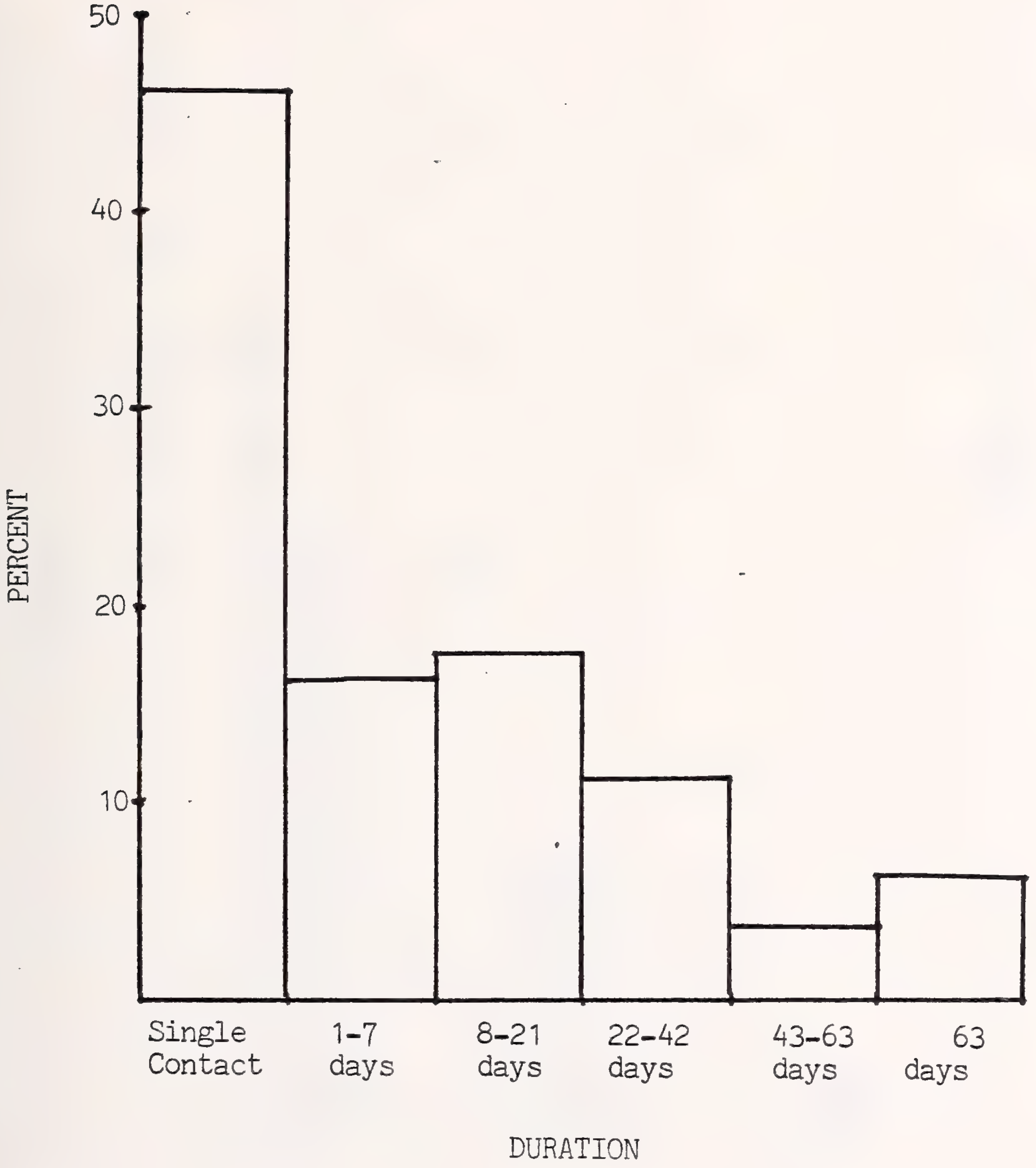


FIGURE 6-4

Distribution of Cystitis Episodes by Duration in Days from First to Last Contact

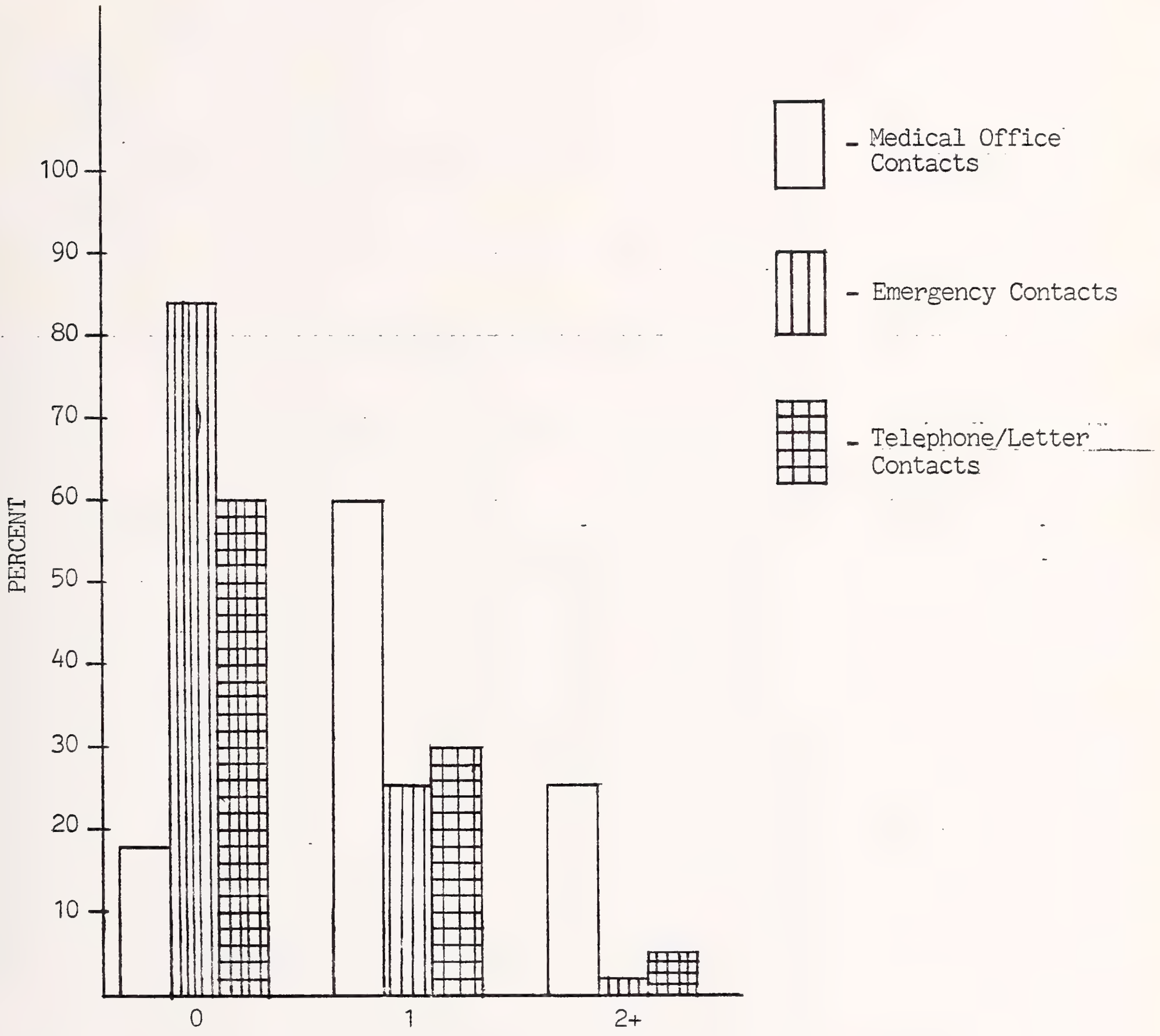


FIGURE 6-5

Percent of All Cystitis Episodes with the Indicated Number of Medical Office, Emergency and Telephone/Letter Contacts

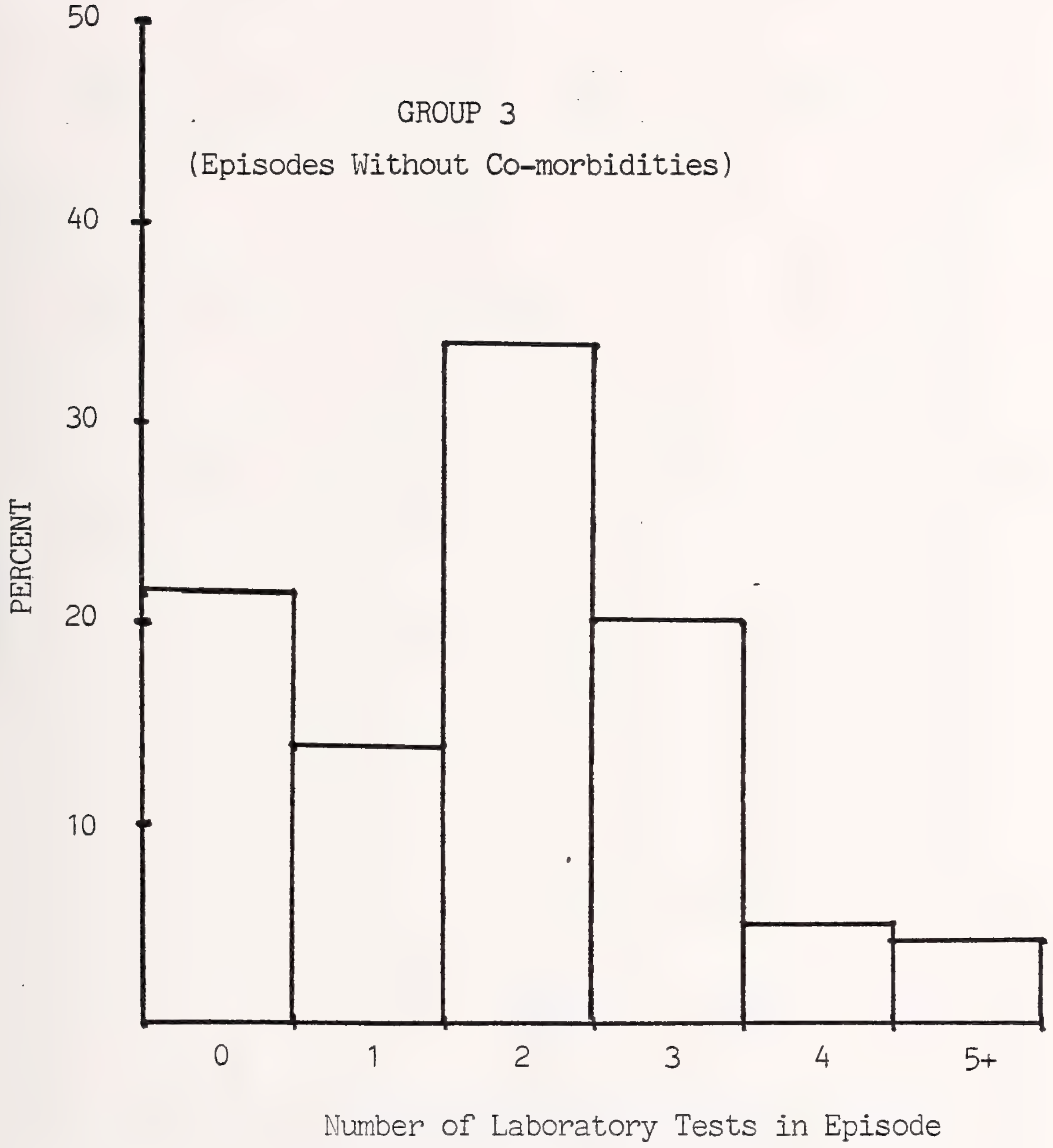


Figure 6-6

Percent of Episodes Without Comorbidities
With Indicated Number of Laboratory Studies

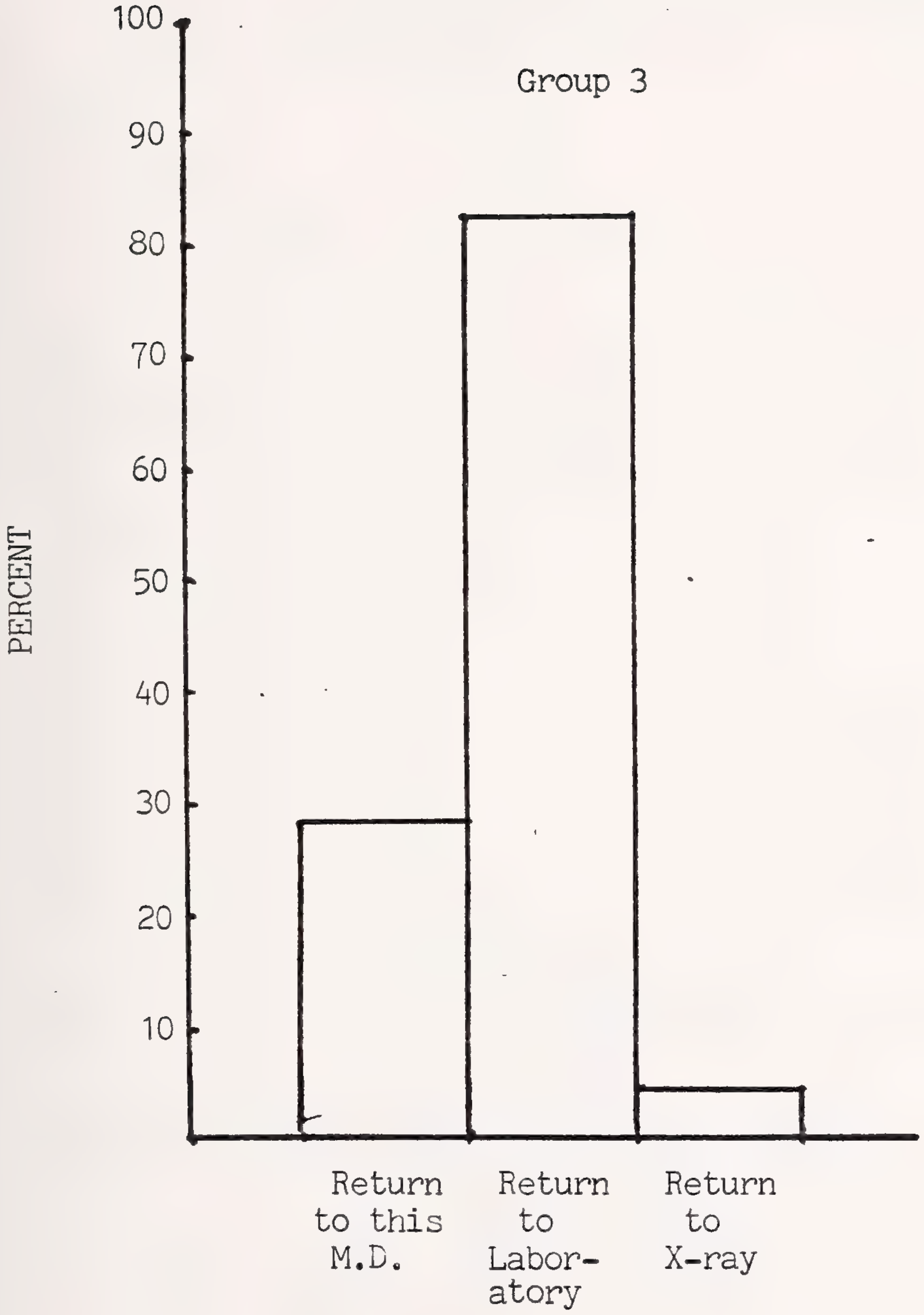
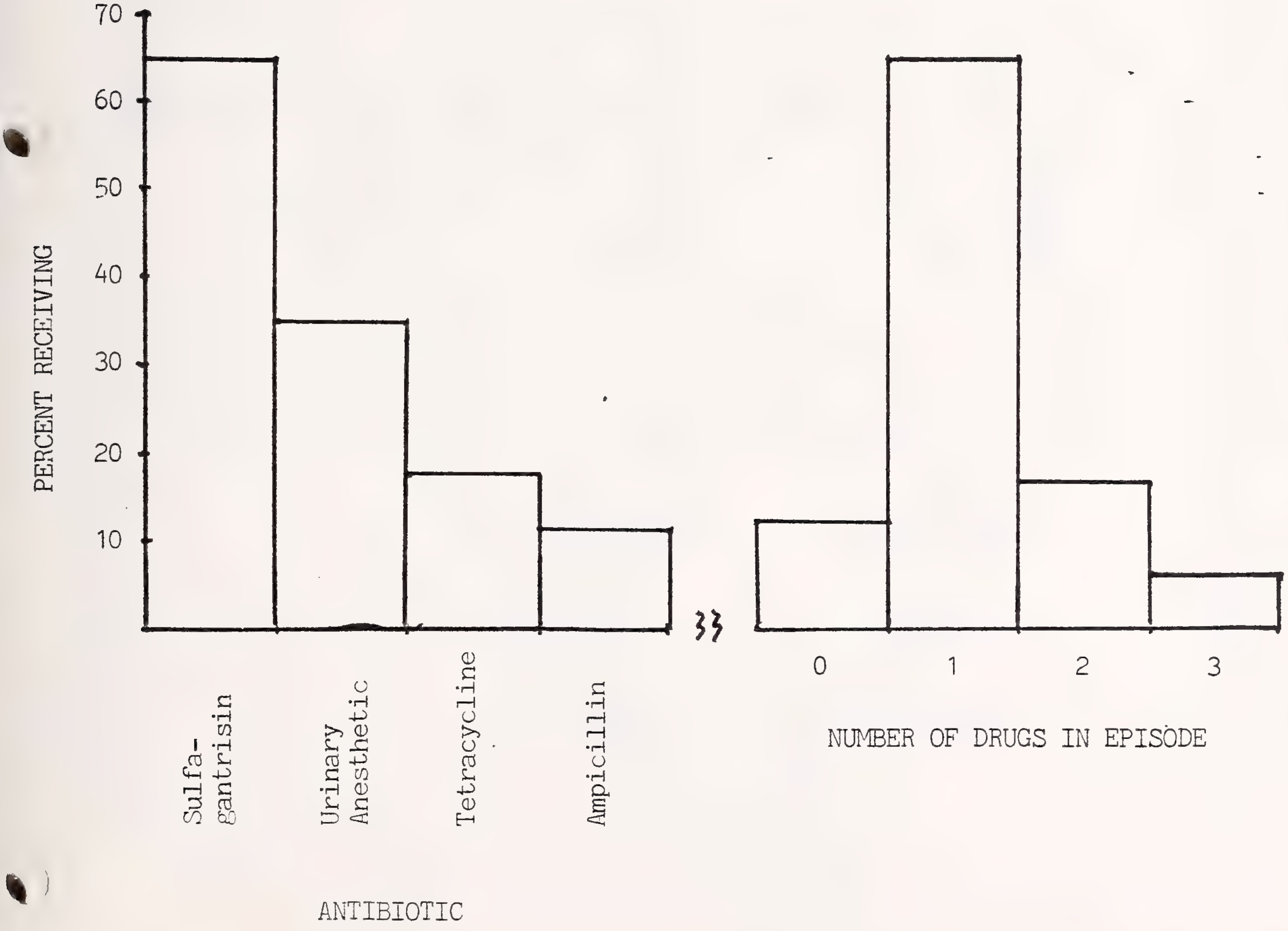


FIGURE 6-7

Percent of Episodes without Comorbidities Present with Return Visits Requested

FIGURE 6-8

Distribution of Drug Orders for Cystitis Among 280 Episodes with Drug Information



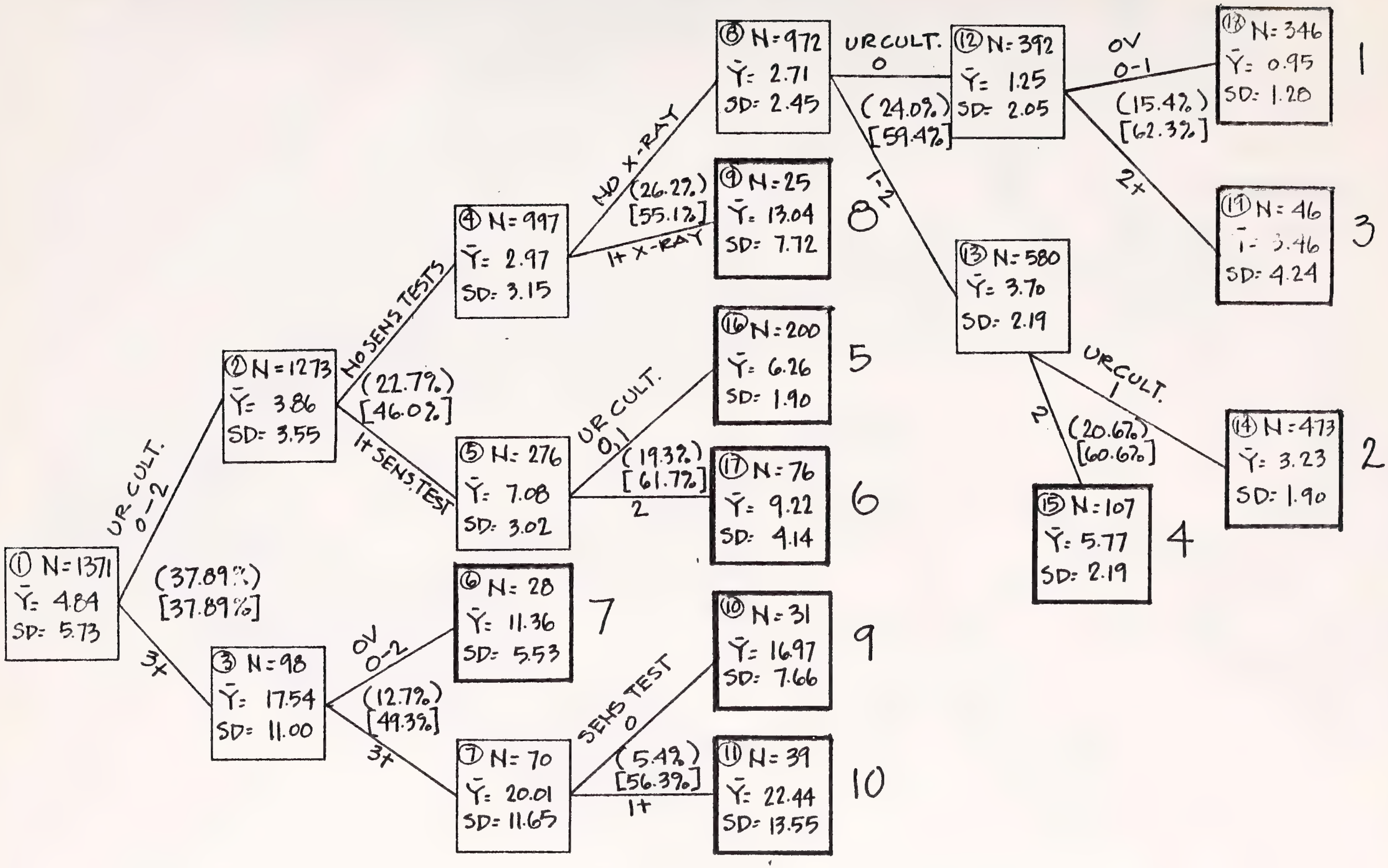


FIGURE 6-9

AID analysis tree in which individual utilization measures are used to predict total RVS per episodes for all cases. Squares contain number of cases (N), mean RVS (Ȳ), and S.D. for episodes in each group. Parentheses contain percent of variation in parent group explained by each split. Brackets contain cumulative variation in parent group explained by all prior splits. Large numbers indicate terminations of bundle pathways.

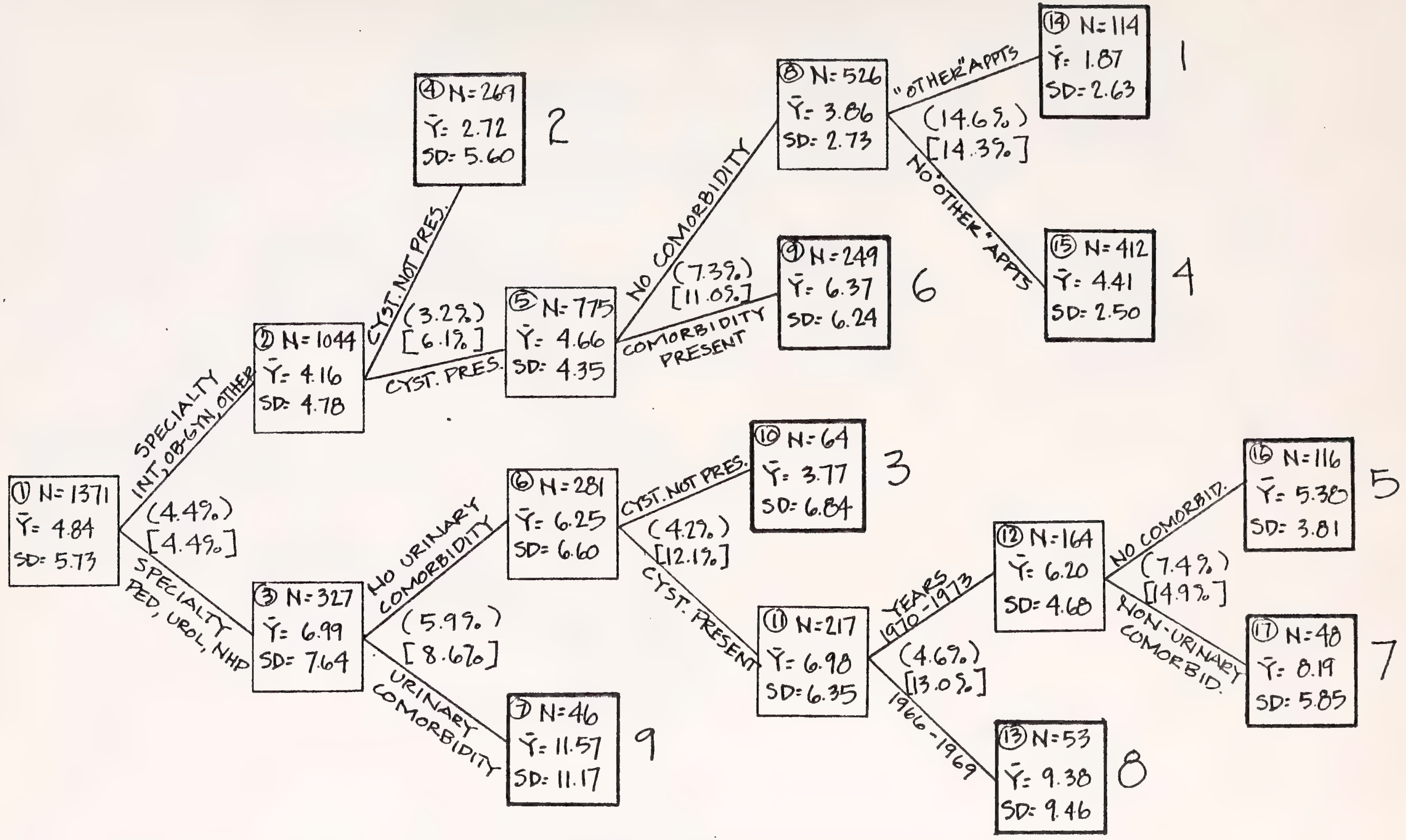


FIGURE 6-10

AID analysis tree in which patient-system characteristics are used to predict total RVS per episode for all cases. Squares contain number of cases (N), mean RVS (Ȳ) and S.D. for episodes in each group. Parentheses contain percent of variation in parent group explained by split. Brackets contain cumulative variation among all cases explained by prior splits. Large numbers identify terminations of pathways in order of increasing RVS charges.

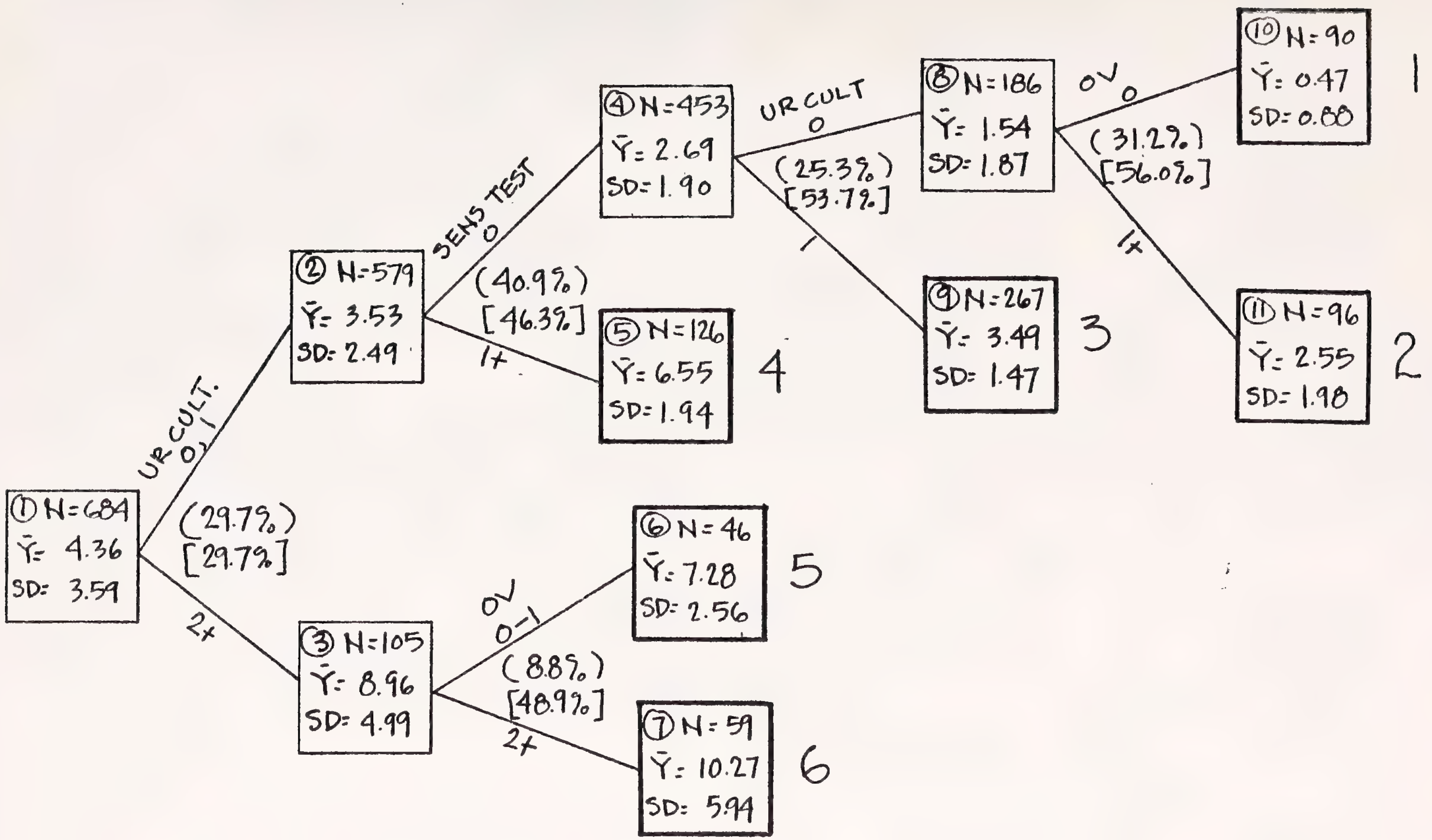


FIGURE 6-11

AID analysis tree in which individual utilization measures are used to predict total RVS per episode for cases with no comorbid conditions. See Figure 9 for explanation of symbols.

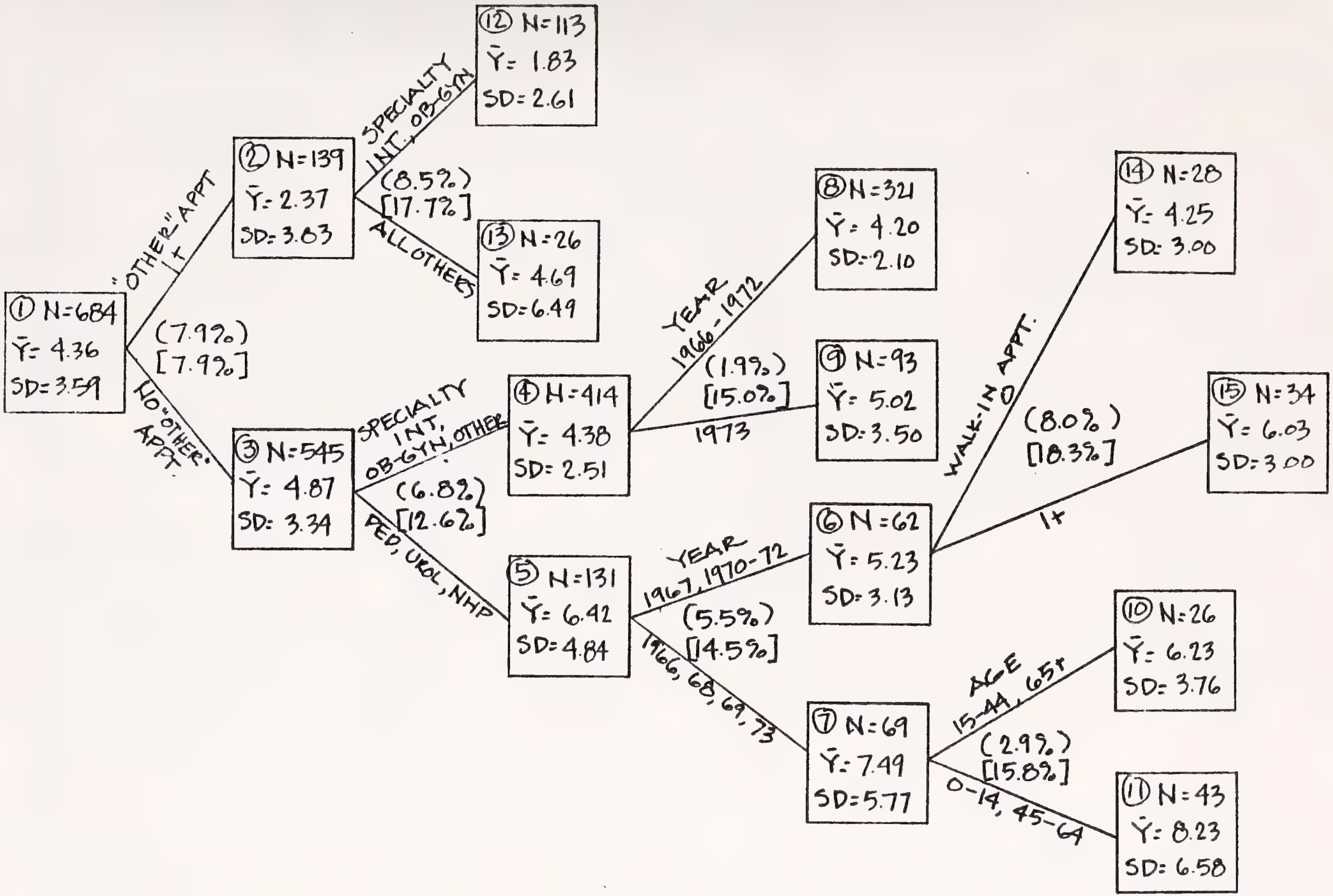


FIGURE 6-12

AID analysis tree in which patient-system characteristics are used to predict total RVS per episode for those cases with no comorbid conditions. See Figure 10 for further explanation of symbols.

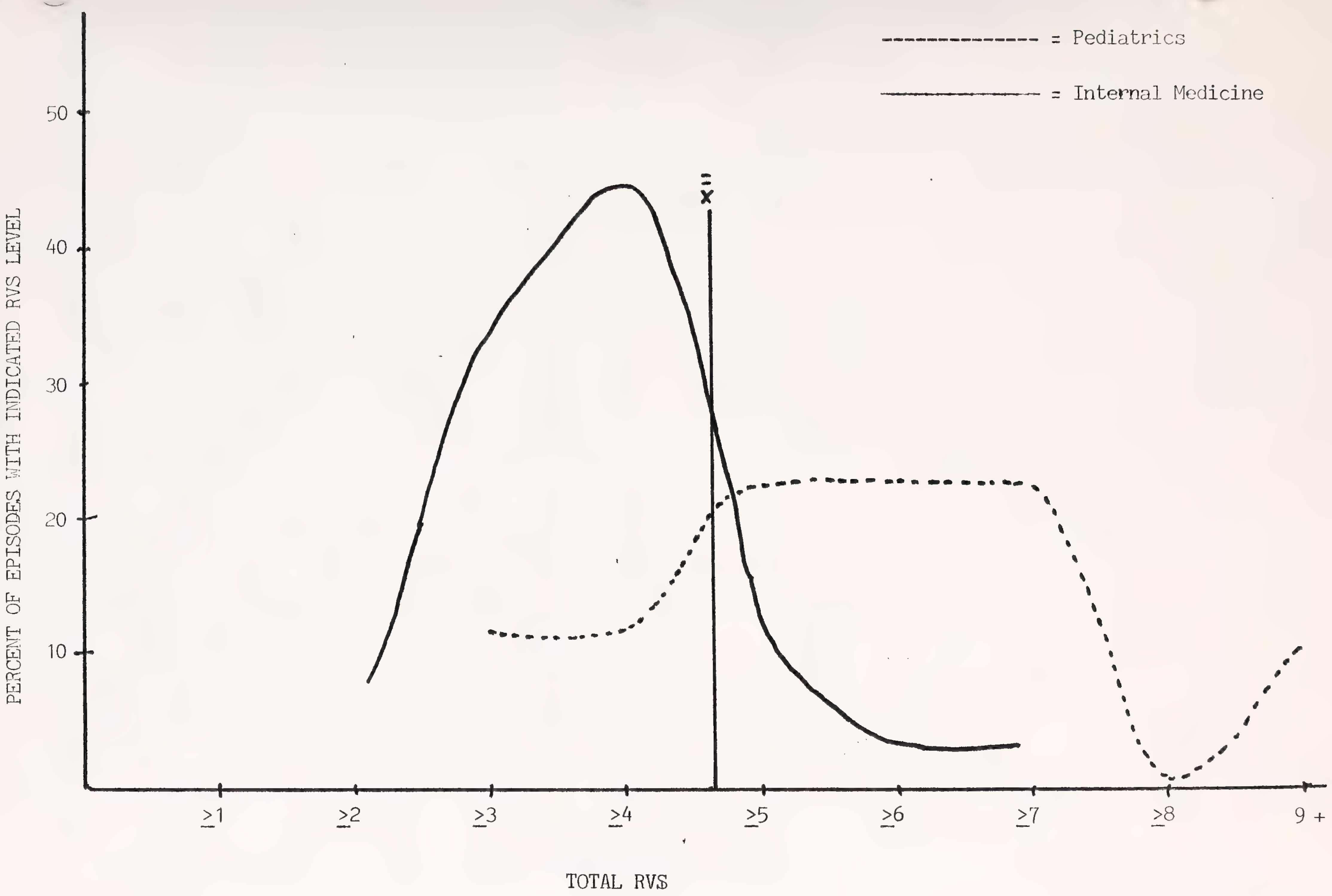


FIGURE 6-13

Percent of Physicians With Mean Total RVS Units as Indicated

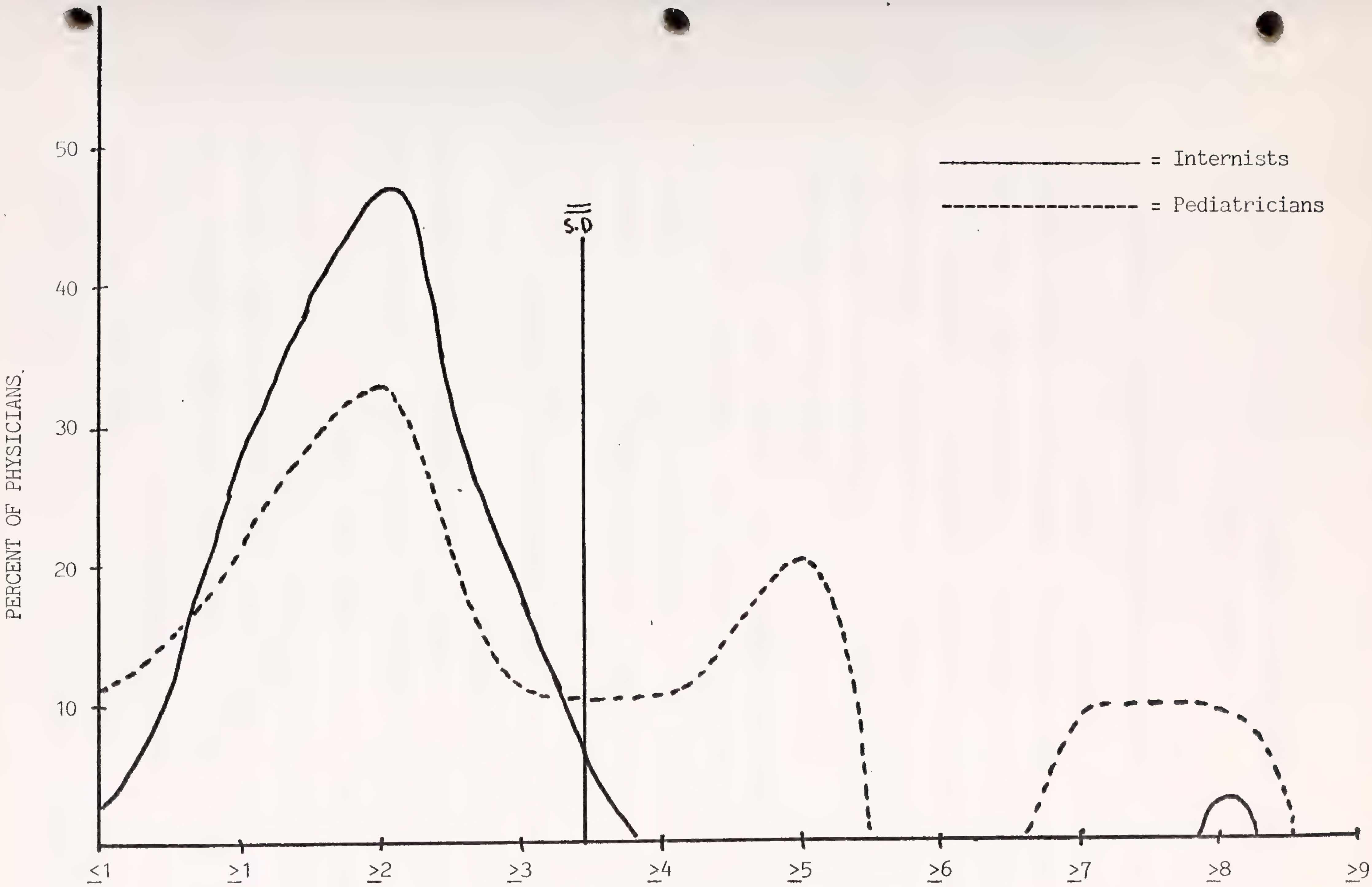


FIGURE 6-14

Percent of Physicians With Standard Deviations of Indicated Values

SECTION VII. ESSENTIAL HYPERTENSION

Rhesa Lee Penn

ABSTRACT

Episodes of hypertension consisted of all contacts for care among persons 18 years of age and over where each contact involved a confirmed diagnosis of hypertension or where the contact for care by a diagnosed hypertensive involved a confirmed diagnosis of an adverse effect of selected antihypertensive duugs. Hypertension is a chronic disease and each episode included all contacts of a person for hypertension during the study period.

A confirmed diagnosis of hypertension required: (1) that one or more contacts in the episode with hypertension as an "established" or confirmed diagnosis; (2) three or more contacts for care of hypertension in the episode; (3) that episodes should be at least six months in duration. There were 465 episodes of hypertension that met all the criteria.

The mean number of contacts per episode was 13 and the mean duration of episodes was 3.7 years. The mean cost per episode was $51. Nine different treatment bundles were identified with the mean costs per episode in the treatment bundles ranging from $5.50 per year to $80.50 per year. The costlier bundles involved more office visits, more radiology and laboratory procedures, and more drug orders than the less costly bundles. The various procedures appear to complement rather than substitute for each other. Resource use was more intensive and mean cost per episode higher during the initial

six months of episodes (the diagnostic workup period) than over the entire episode.

Increased patient age was associated with lower mean costs per episode and mean episode costs were higher for episodes beginning in or after 1971 than those beginning in or before 1970.

Variations in costs of hypertension episodes appear to be largely due to quantitative (not qualitative) differences in resource use and to post-1970 profession- wide changes in standards of treatment. Further specification of the determinants of episode costs appears to require additional data that is largely obtainable from the medical record.

I. INTRODUCTION

This report examines essential hypertension, a chronic disease with highly variable patterns of severity, long-term monitoring, diagnostic workup, and treatment. Essential hyper-ension is a condition characterized by sustained elevation of blood pressure above "normal" levels (140/90 mmHg is the commonest cutoff point used for adults), and having no readily identifiable or correctable course. Hypertension is associated with an increased risk of stroke and heart disease. In 1970 the results of a clinical trial were published which indicated that drug treatment of moderate elevations in blood pressure significantly reducted mortality.[1] This trial had a strong influence on the tendency of physicians to prescribe medications for the condition.

The report is based on data from computerized medical records for a 5 percent sample of all subscriber units in the Kaiser-Permanente Medical Care Program (KPMCP) of Portland, Oregon between September 30, 1966 and December 31, 1973.

II. EPISODE DEFINITION

The hypertension data file included all contacts for care among people 18 years of age or over, if the contact was associated with an updated presenting morbidity of essential hypertension (447.0, International Classification of Diseases,

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[1] Veterans' Administration Cooperative Study Group on Antihypertensive Agents. Effects of treatment on morbidity in hypertension. Results in patients with diastolic blood pressures averaging 90 through 114 mmHg. JAMA 1970; 213(7): 1143-1152.

Adapted, 7th edition). For people with a diagnosis of hypertension, the file also included contacts with these updated presenting morbidities: 965.9, adverse effect of other electrolytic, caloric, and water balance agents; 980.7, adverse effect of other hypotensive agents; 985.0, adverse effect of mercurial diuretics; 985.3, adverse effect of saluretics; and 985.9, adverse effect of other diuretic agents.

An episode began with a patient's first Health Plan contact at which hypertension or a related adverse drug reaction was an updated morbidity, either presenting or associated, and it ended with the patient's last such contact. This time interval defined the duration of an episode of care within the Health Plan, not a complete episode of illness. It was possible that a patient had high blood pressure before entering the Health Plan. In addition, hypertension will continue for the patient's lifetime. The application of these criteria resulted in the identification of 881 episodes of hypertension for the study period.

The first step was an attempt to assure that hypertension was a confirmed disease in the episodes identified. Episode team physicians agreed on three criteria that needed to be sat-sfied to confirm an episode for analysis. They were:

(1) At least one contact in each episode should have hypertension coded as an "established" diagnosis. Table 7-1 shows that 8 percent failed to meet this criterion.

(2) Each episode should include at least three medical office contacts at which hypertension was a presenting or

associated morbidity; 40.6 percent failed to meet this criterion (Table 7-2).

(3) Each episode of hypertension should encompass at least six months. This criterion allows time for multiple medical office contacts in which to establish the diagnosis by blood pressure readings, perform a diagnostic workup, and begin therapy. As Table 7-3 shows, 42.9 percent of the episodes lasted less than six months.

Of the 881 episodes of hypertension, 465 met all three criteria. The confirmed episodes were compared with the unconfirmed episodes by the nature and extent of resources used in the episodes. Unconfirmed hypertension episodes were much less likely than confirmed episodes to receive care for the disease (Table 7-4). Of the confirmed hypertension episodes, 3.4 percent had no dollar cost assigned to them, while 50.5 percent of unconfirmed episodes had no dollar cost assigned.[2] Other data indicated that physician requests at

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[2] The HSRC data system procedures provided for the coding of office visit RVS units and dollar costs to a hypertension contact if hypertension was noted in the medical record as the primary reason for the visit. If an office visit was made and hypertension was not the primary reason for the visit, but was an associated morbidity, the RVS units and dollar costs of the office visit were charged to the presenting morbidity, not to the hypertension. RVS unit and dollar costs associated with a laboratory test or an x-ray were charged to hypertension only if it was noted in the chart that the tests were done for hypertension--not for a physical examination or a different, coexisting disease. Thus, an episode of hypertension may have had no RVS units assigned to it if no tests were noted as being performed for that illness, and if no medical office visits were made primarily to diagnose, treat, or monitor hypertension.

the index contact to follow up on diagnosis and care of the disease did not appear to be related to whether or not hypertension was confirmed (Table 7-5). However, confirmed episodes were significantly more likely to include requests for return for further care when the complete episodes were considered (Table 7-6).

Other possible reasons for unconfirmed hypertension episodes are:

(1) Physician judgment that the hypertension was so mild as to be of little concern. This could have been more common during the earlier years of the study period, because treatment of "mild," "labile," or "borderline" hypertension had not yet become standard practice.

(2) Truncation of ongoing episodes by the end of the study period. Of episodes beginning from 1966 through 1971, 44 percent were confirmed. In 1973, when 159 episodes began, only 6.3 percent met the criteria for confirmed hypertension. Episodes beginning in 1972 and 1973 were less likely to meet the criteria due to the brief time that data was collected about them.

(3) Patient departure from the Health Plan.

III. ANALYTICAL APPROACH

The analysis of hypertension initially involved description of episodes of "confirmed" hypertension, using measures of utilization, patient and provider characteristics, and medical care process characteristics. The entire episode was examined, as well as a workup period covering the first six months of the episode.

Using dollars per episode year and total dollar cost for the initial six-month workup period, each patient, provider, and medical care process variable was examined to determine whether or not the variable was significantly related to resource use.

The Automatic Interaction Detection (AID) program was then used to determine (1) the subcomponents of utilization and (2) the combination of patient, physician and medical care process variables that best explained the variation in resource use. The final step was a Log Linear Multiple Classification Analysis (LLMCA) which identified the extent to which an episode's patient, provider, and medical care process characteristics influenced the likelihood of having received a given bundle of resources.

To meaningfully compare resource use for hypertension episodes, which varied in length from six months to 7.2 years, it was necessary to adjust total resource use by episode duration. This was done by using dollar cost per year of episode duration as a primary measure of total resource use. The initial six-month workup period was examined separately, with total dollar cost over that period used as a second measure of resource use.

An HSRC survey of persons who were Health Plan members for the full years 1969 and 1970 showed that only 8 percent of adults reported having used outside physician services in the year preceding the survey.[3] Few who were not eligible for

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[3] Pope CR, Freeborn, DK, Greenlick MR. Use of outside physicians by members of a group practice prepayment plan. Presented at the Annual Meeting, American Public Health Association, November, 1972.

prepaid medical care came to the Health Plan for outpatient care; only 21 (4.5 percent) of 465 hypertension episodes included any Health Plan contacts at which the patient was ineligible for prepaid care. Further, the eligibility, month-by-month, of 406 hypertension episodes that lasted at least six months was examined. Only 27 (6.6 percent) of the 406 episodes had a discrepancy of two or more months between eligibility during the episode and total duration of the episode. Patients with long episodes of care tended to remain in the Health Plan during their entire episode of care. Therefore, rates of resource use were based on duration of episodes from first to last contact, without adjusting for gaps in eligibility within the episode.

IV. DESCRIPTION OF THE POPULATION

A. Patient Characteristics

A comorbidity is any condition other than hypertension that was present and diagnosed at the time of any contact for hypertension. Comorbidities were examined because of their potential influence on the cost of treatment. Comorbidities chosen for analysis were those defined as possible causes or complications of hypertension, or--as with gout and drug reactions--adverse effects of treatment. Comorbidities chosen for analysis were:

(1) Obesity (287.0)

(2) Oral contraceptives (Y008)

(3) Pregnancy (640.0-689.0, Y060, Y070)

(4) Diabetes (260.0-260.9)

(5) Gout (288.0)

(6) Cerebrovascular disease (331.0-335.1)

(7) Heart disease (420.0-420.9, 421.5, 422.1, 433.1, 433.2, 436.0, 436.6, 436.7, 436.9, 442.0, 443.0, 447.6)

(8) Renal disease (446.0, 447.1, 591.0, 592.0-603.5, 792.0)

(9) Vascular disease (450.0-452.0, 453.3-453.9)

(10) Drug reactions (965.9, 980.7, 985.0, 985.3, 985.9)

Table 7-7 shows the frequency of these diseases. A patient was counted as having a given comorbidity if that comorbidity was present in one or more contacts during the episode. Obesity was the most common comorbidity, affecting 51 percent of hypertensive episodes. Heart disease affected 21.9 percent; 15.9 percent had diabetes; adverse drug reactions were noted in 8.8 percent; and 8 percent of episodes had cerebrovascular disease represented. The combinations of comorbidities present among the episodes is shown in Figure 7-7.

In a further attempt to define episodes of hypertension of comparable severity, the 465 episodes were sorted into five mutually-exclusive comorbidity groups:

(1) Episodes with cardiovascular disease other than hypertension (heart disease, vascular disease, cerebrovascular disease). (N=140)

(2) Episodes with diabetes, and without cardiovascular disease. (N=51)

(3) Episodes with obesity, and without diabetes or cardiovascular disease. (N=134)

(4) Episodes without any of the comorbidities in groups 1-3, but with contraceptive use, renal disease, or pregnancy as a comorbidity. (N=6)

(5) Episodes without any of the comorbidities in groups 1-4. (N=134)

This grouping attemped to sort episodes according to the presence of different comorbidities which appeared to be most likely to alter resource use in the treatment of hypertension.

While these groups were an attempt to stratify hypertension episodes by severity, neither blood pressure data nor weight were available. In addition, it was not possible to assess changes in severity of comorbidities (i.e., reduction to normal weight or progression from mild to severe diabetes) over the course of the episode.

Fifty-six people (12 percent) had a tentative (as opposed to established) diagnosis of hypertension at the first contact (Table 7-8). Hypertension was the presenting morbidity--the primary reason for the first contact--in 23.7 percent of the episodes (Table 7-9). In the other episodes, the first visit was due to another illness, and hypertension was an associated morbidity. On the average, hypertension was the presenting morbidity in 50.5 percent of all contacts.

Hypertension rarely occurred without comorbidities (Table 7-10). On the average, each episode had 2.3 diagnosed conditions coexisting with hypertension at the start of the episode.

The mean patient age at the start of the episode was 56.3 years. Figure 7-2 shows that the largest age group included patients of age 50-64. The sex distribution was 41 percent male and 59 percent female.

The largest proportion of episodes, 24.3 percent, began in 1967 (Table 7-11). The small number of episodes beginning in 1973 was a result of the criteria used to select episodes for analysis.

Table 12 shows the distribution of episode duration--the time between each patient's first and last contact for hypertension or for an adverse reaction to antihypertensive drug therapy. There was a wide range of episode duration; the mean duration was 3.7 years.

An episode was coded as continuing if, at the first contact, the patient's chart indicated that s/he had received care for hypertension within the Health Plan prior to the initiation of the data system. A new episode was one in which the patient's record did not show previous care for hypertension within the Health Plan. This included those diagnosed as hypertensive for the first time, but also included those who may have previously received care for hypertension outside the Health Plan. Due to this coding procedure, it was possible that some of the 313 episodes identified as new episodes may have had a previous diagnosis of hypertension.

B. Provider Characteristics

Virtually all care for hypertension was given by physicians (Table 7-13). At the initial contact, only one patient

was cared for by a nonphysician, and there were 27 episodes (5.8 percent) that received some nonphysician care over the entire episode.

Table 7-14 indicates that most hypertension episodes began with a visit to an internist. Over the entire episode, 79.6 percent of episodes visited only internists. The mean number of contacts with an internist was 12.7. Few episodes included a referral to a specialist who might treat hypertension complications.

Most episodes began with a visit to the patient's regular physician (Table 7-15). Only 7 percent of all episodes included a patient visit to a consultant physician.

C. Medical Care Process Characteristics

Four persons were ineligible for program benefits at the index contact and only 21 (4.5 percent) were ineligible at one or more contacts during the episode (Table 7-16). Most were eligible for care during the full calendar year that included their index contact.

Almost all hypertension episodes began with a visit during regular medical office hours (Table 7-17). Almost 30 percent had one or more contacts outside normal office hours. Of those who sought care outside regular hours, 65.4 percent did so only once during the episode.

Eighty-three percent of the episodes began with a regularly scheduled contact for care (Table 7-18). While 12.3 percent of episodes began with a walk-in visit, 48.6 percent

of all episodes included at least one walk-in visit. Walk-in visits were 7.6 percent of total contacts during the episodes.

V. UTILIZATION DESCRIPTION, ENTIRE EPISODE

A. Types of Contacts

Table 7-19 shows the frequency distribution of total patient contacts for hypertension. The number of contacts per episode ranged from three to 77. The mean number of contacts per episode was 13. Included in these contacts were: hospital admissions, outpatient medical office visits, emergency room visits, and telephone calls or letters to or from the patient. Contacts were counted if hypertension was either the presenting morbidity or an associated morbidity for that contact. The distribution of these types of contacts for all episodes is given in Table 7-20.

If hypertension was found at the time of a hospital admission, that contact was included in the hypertension episode as an inpatient contact, whether or not hypertension was the primary reason for the admission. About 1 percent of hypertension episodes began with a hospital admission, but 11.6 percent of all hypertension episodes included at least one hospitalization. There were five episodes (with a total of eight hospitalizations) in which hypertension was the primary discharge diagnosis. The length of stay in these eight hospitalizations averaged 5.2 days. The hospital admissions in the other episodes were for a wide variety of heart, gastrointestinal, central nervous system, bone, traumatic, and respiratory disorders.

The number of medical office contacts per episode ranged from three to 60, with a mean of 11.0. Medical office contacts accounted for 86.1 percent of the contacts in an "average" hypertension episode.

Nine percent of episodes included an emergency room contact. This, with the low frequency of walk-in contacts and contacts occurring out of regular office hours, suggests that urgent care for hypertension is not frequent.

More than one-half of all episodes (58.7 percent) had at least one telephone or letter contact; the mean number of such contacts was 1.7. Telephone and letter contacts represented 11.2 percent of total contacts in an average episode.

One or more telephone calls were made in 50.7 percent of the episodes. Seventy-five percent of all phone calls were related to drug therapy for hypertension (Table 7-21).[4]

Table 7-22 shows the frequency distribution of different types of medical office contacts. If a patient's medical

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[4] These drug-related telephone calls were:

Code No.	Procedure Name
9082	Patient calls regarding symptoms; given prescription
9086	Drug refill request from patient or pharmacist
9091	All other calls to physician or health professional by patient regarding medication
9093	Physician call to patient to adjust medication
9095	Patient calls regarding lab test results; given prescription
9097	Patient called for refill; not given until patient sees physician

These codes are from the HSRC adaptation of the 1964 California Relative Value Scale.

office contact was for hypertension as the presenting morbidity, the office visit cost was counted as part of the total costs of care for the hypertension episode. The contact may have been coded as an initial office visit, at a 1970 dollar cost of $10; as a follow-up office visit, at a cost of $5; or as a complete physical exam, at $17.50. Only 13.5 percent of all episodes had an initial office visit coded to their hypertension episode. Most episodes, 89.9 percent, had at least one follow-up office visit for hypertension. The mean number of such visits is 5.4, with a range from zero to 42.

Most episodes, 90.3 percent, included at least one physical examination; the mean number of such contacts was 2.8, with a range of zero to 11. A physical examination may have been noted whether hypertension was the presenting or associated morbidity in the contact. Very few episodes, 3.2 percent, had a physical examination performed at contacts for which hypertension was the presenting morbidity.

On average, 26.3 percent of contacts were physical examinations (Table 7-23). Only 8.6 percent of all episodes had physical examinations at more than one-half of their contacts. The mean number of physical examinations per year was 0.9 (Table 7-24).

The mean number of medical office contacts per patient per episode year was 3.5 (Table 7-25). The rate ranged from one visit every two years to 21.1 visits per year. Some episodes with 10 or more office contacts per year were

six-month episodes with five or six contacts; others had frequent office visits over a two-to-seven-year period. Over half of the medical office contacts (mean, 1.8 per year) were follow-up office visits with the cost charged to hypertension.

B. Laboratory and Radiology Workup

Table 7-26 shows that 73.3 percent of all hypertension episodes had at least one laboratory test coded to them. The mean number of tests per episode was 4.3, with a range of zero to 34. Fifty episodes, 10.7 percent, had 11 or more laboratory tests. Radiology procedures were done in 26.3 percent of the episodes. The mean number of such procedures per episode was 0.3, with a range of zero to five.

The frequency of the specific radiology procedures coded to hypertension is given in Table 7-27.[5] Among the episodes, 16.6 percent received at least one chest x-ray (to detect cardiomegaly) and 13.1 percent received at least one intravenous urography to detect renal disease. Only 13 episodes (2.8 percent) received both a chest x-ray and an intravenous urography (Table 7-28).

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[5] Procedures referred to in tables are: chest x-ray, one or two views (7100, 7101); intravenous urography, or urography with hypertensive dye, or retrograde urography (7372-7374); complete blood count, or hematocrit with white cell count with blood differential (8622 + 8624 + 8681, 8628); creatinine or BUN or creatinine clearance (8664, 8665, 8745); phosphorus, potassium, or sodium (8707, 8709, 8721); glucose cola (8722); uric acid (8747); catecholamine and VMA (8935); urinalysis (8936); EKG (9101); and these thyroid tests: T3 or T4 or PBI (8757, 8758, 8710). All procedure numbers are from the 1964 CRVS, as adapted by the HSRC staff.

Table 7-29 shows the frequency of the laboratory tests most commonly associated with hypertension. The tests most commonly given were BUN/creatinine (28.8 percent of episodes with one or more), potassium (56.3 percent with one or more), sodium (33.1 percent with one or more), and ECG (24.9 percent with one or more). During the episode these patients may have also received other laboratory tests relevant to hypertension but which were coded to a co-morbidity such as heart disease or diabetes.

The various types and combinations of laboratory tests that were ordered are shown in Table 7-30. The most common was not to order laboratory tests (26.7 percent of episodes). Electrolytes alone were ordered in 10.5 percent; electrolytes and at least one miscellaneous test (other than an EKG, electrolyte, or creatinine) were ordered in 13.5 percent. At least one creatinine, one electrolyte, and one miscellaneous laboratory test were ordered in 11.2 percent. Patients received a mean of 1.6 laboratory tests per episode year for hypertension with a range of zero to 18 tests per episode year (Table 7-31).

C. Drug Therapy

Because collection of drug order data began in 1972, this information is available only for 65 hypertension episodes which began in 1972 or 1973.

The frequency of various types of drug orders appears in Table 7-32. Among the 65 episodes, 87.7 percent received at

least one drug order; 72.3 percent received one or more diuretic orders; 35.4 percent received one or more orders for nondiuretic antihypertensive drugs (e.g., alphamethyldopa, hydralazine). The mean number of drug orders per episode was 4.7, including 2.6 diuretic orders and 1.6 other antihypertensive orders.

Table 7-33 shows the combinations of drugs ordered in the episode. Two-fifths of the episodes received only diuretic orders. The next most common pattern was orders for diuretics, for nondiuretic antihypertensive drugs, and for other drug types. The third most common pattern was for no drugs to be ordered.

D. Cost of Episode Management

Table 7-34 shows the distribution of the costs for episodes of care of hypertension (excluding drugs and inpatient care). The mean total dollar cost per episode was $50.77; costs ranged from zero dollars to $321.70. A mean of 29.5 percent of all costs were attributable to laboratory tests; 8.4 percent to radiology; 53.7 percent to medical office visits; 3.8 percent to telephone calls; 0.5 percent to letters to or from the patient; and 0.4 percent to miscellaneous care.

The mean laboratory cost per episode was $14.99. There were no laboratory costs in 26.7 percent of the episodes, while the highest laboratory cost was $125.70. The mean radiology cost per episode was $4.28. There were no radiology costs in 72.7 percent of all episodes; the highest radiology

cost was $66. Total office visit costs averaged $29.10 per episode. Only 8.6 percent of all episodes had no office visit costs; the highest total cost for office visits was $220.

Total dollar cost per year of episode duration is shown in Table 7-35. Episodes had an average cost of $18.45 per year. The range of costs was from $0.00 to $153.68 per year.

VI. UTILIZATION DESCRIPTION, INITIAL SIX-MONTH WORKUP

This section examines utilization of resources for the diagnosis, monitoring, and therapy of hypertension for the initial six months of care, to determine if the period immediately following diagnosis differed in resource utilization from the total episode of care.

A. Types of Patient Contacts

Table 7-36 shows the distribution of different types of patient contacts with the system in the first six months of the episode. To determine how much of the care was concentrated in the initial workup period, the proportion of care rendered during this period was compared to the proportion expected assuming equal distribution of care throughout the episode.

The workup period of six months constituted 13.6 percent of mean episode length. The mean number of hospital admissions per episode in the workup period was 22.7 percent of mean hospital admissions for the total episode, indicating that hospital admission was roughly 1.5 times as common in the workup period as over the entire episode. The same was true for medical office contacts and emergency room contacts.

The distribution of medical office contacts for the workup period is shown in Table 7-37. Only 9.5 percent of all episodes had an initial office visit coded to hypertension during the workup period. Follow-up office visits for hypertension occurred in 60.2 percent of all episodes, with a mean of 1.3, and a range of zero to 13. Follow-up office visits were more frequent in the workup period than over the entire episode.

B. Radiology and Laboratory Services

Table 7-38 shows the distribution of laboratory and radiology procedures given during the workup period. A majority of patients received no procedures during the workup period. Laboratory and radiology procedures were more likely to be given in the workup period than over the rest of the episode. This was especially true of chest x-rays, intravenous urography (IVU), glucose, VMA/catecholamine, urinalysis, and ECG. For each of these, the mean number of tests given in the workup period was at least 35 percent of the episode mean, although the workup period was only 14 percent of the whole episode.

C. Drug Therapy, Episodes Beginning 1972-1973

Table 7-39 shows that 73.8 percent of all episodes received at least one drug order during the workup period; the mean was 2.6, with a range of zero to 11. Diuretics, given to 63.1 percent of episodes, were the most commonly ordered drug type. Drug orders appeared to be more intensive during the workup period since it was 43.9 percent of the mean episode

duration, while 50 to 59 percent of the drug orders were made during this period.

D. Cost of Care in the Workup Period.

The distribution of costs of care for the workup period appears in Table 7-40. The mean workup cost per episode was $14.60, with a range of zero (28.4 percent of all episodes) to $93.20. Mean workup period costs were 28.7 percent of mean total episode costs. Since the workup period was 13.6 percent of mean total episode length, this indicates more intensive resource use during the initial six months of the episode. Of the cost components, radiology costs were the most concentrated in the workup period, followed by laboratory costs. Radiology represented 14.4 percent of mean workup period costs and 8.4 percent of the entire episode costs. Laboratory costs during the first six months represented 31.2 percent of total workup costs, which is similar to the 29.5 percent of total episode costs that was represented by all-episode laboratory costs. Medical office visits and procedures were 54 percent of the workup costs, and 62 percent of total episode outpatient cost.

VII. SUMMARY OF KEY DESCRIPTIVE FINDINGS, ALL 465 CASES

1. The most common comorbidities with hypertension were obesity, cardiovascular disease, and diabetes. Very few patients reported symptoms at their index contact.

2. In most cases, 85 percent, the diagnosis of hypertension was established at the initial episode contact.

Hypertension was the presenting morbidity at the index contact in 23.7 percent of all episodes and was the presenting morbidity in one-half of all episode contacts.

3. The mean patient age was 56.3 years; 59 percent of the patients were female. Episode duration varied from six months to 7.15 years, with a mean of 3.7 years.

4. Most outpatient care was given at regularly scheduled appointments within regular medical office hours by internists who were the patient's regular physician.

5. Almost 12 percent of hypertension episodes included hospitalizations. Most of these were for other illness as the primary complaint, with hypertension as a secondary problem.

6. The mean number of contacts for care was 13.1 per episode. There was an average of 11 office contacts per episode, including a mean of 5.4 follow-up office visits at which hypertension was the presenting morbidity. Hypertension episodes averaged 3.6 medical office contacts per year.

7. Most episodes (90.3 percent) included one or more physical examinations. Rarely was this examination done primarily for hypertension. An episode had an average of one physical examination per year; one-fourth of all contacts were physical examinations.

8. Emergency room contacts were present in 9 percent of all episodes. Only a few were the immediate prelude to hospitalization, or noted hypertension as the presenting morbidity.

9. One-half of all episodes included one or more telephone calls; three-fourths of these calls were drug-related.

10. About three-fourths of the episodes had at least one laboratory test; the mean number per episode was 4.3; a mean of 1.6 tests per year were given. Three-fourths of those who received any laboratory tests were given at least one potassium test; other commonly given tests were sodium, BUN/creatinine, and ECG.

11. Radiology procedures, usually a chest x-ray or intravenous urography, were given in about one-fourth of all episodes.

12. Drug orders were given to 87.7 percent of all hypertension patients whose episodes began in 1972 or 1973. Diuretics alone were the most common pattern of drug therapy. The next most common approach was a combination of diuretics, non-diuretic antihypertensive drugs, and other miscellaneous drugs.

13. The mean outpatient dollar cost for handling an episode of hypertension (exclusive of drug costs) was $50.77, or $18.45 per episode year. The largest share of dollar costs (57.3 percent) was attributable to medical office visits. Laboratory costs followed, at 29.5 percent of total costs. Sixteen episodes (3.4 percent) had no dollar cost attributed to the episode of care; the most expensive episode had a total cost of $321.70.

14. During the initial six months of the episode, the rate of resource use, as measured by dollar cost, number of

patient contacts with the system, laboratory tests, and radiology procedures was higher than over the entire episode.

15. The mean number of medical office contacts per patient in the workup period was 2.8, which included 1.3 follow-up office visits specifically for hypertension. These diagnostic procedures were highly concentrated into the workup period: chest x-rays, intravenous urography, glucose, VMA/catecholamines, urinalysis, and ECG. The tests most commonly given were ECG, creatinine, and electrolyte. Drug therapy was given to 73.8 percent of episodes in the workup period; 63.1 percent of all patients received diuretics. The mean cost per episode during the first six months was $14.60, with a range of zero to $93.20.

VIII. BIVARIATE ANALYSIS

A. Entire Episode

This section examines how total resource use, as measured by dollar cost per episode year, varied as a function of patient, provider, medical care process, and selected utilization variables. This information is presented graphically in Figures 7-3 through 7-20. In each graph, the middle number in each bar is the mean resource use for the given subgroup; the upper and lower numbers show the range of two standard errors above and below the mean for each subgroup. The p-value shows the significance level of the variable's relationship to resource use; ETA^2 shows the proportion of all episode resource use variation which is explainable by variation in the predictor variables alone.

1. Patient Characteristics

Figure 7-3 shows that the rate of cost per episode year was significantly related to patient age at the index contact. Variation in costs was greatest for those under 35 and those over 75. Mean resource use was lowest in the 65-74 age group.

The effect of comorbidity group on costs is shown in Figure 7-4. Comorbidity groups were: (1) cardiovascular disease; (2) diabetes without cardiovascular disease; (3) obesity without diabetes or cardiovascular disease; (4) renal disease, pregnancy, or oral contraceptive use without any of the preceding comorbidities; and (5) a "clean" group--patients with none of the specified comorbidities. Costs were related to comorbidities. Episodes with no comorbidities had the greatest mean cost per episode. This finding may be an artifact of the coding system. A person with numerous comorbidities in a contact was more likely to have dollar charges for an office visit or a diagnostic test coded to some disease other than hypertension than was a person with few comorbidities.

Figure 7-5 attempts to show if comorbidity group influenced the mean annual rate of medical office contacts. No significant relationship was observed.

Episodes with adverse drug reactions had significantly different costs per year than did those without drug reactions (Table 7-41). Patients with drug reactions had higher cost episodes and had more medical office contacts per

year. Their higher rate of resource use was not an artifact of whether hypertension was coded as an associated rather than as a presenting morbidity.

The year of index contact was significantly related to mean cost per episode and explained 27 percent of variation in costs per episode (Figure 7-6). Costs per year were stable until 1970, increasing steadily and sharply thereafter. It appears that an intensification of diagnostic and therapeutic workups for hypertension occurred during and after 1971, a time coincident with the initiation of Public Health Service efforts to increase the frequency of diagnosis and treatment of hypertension.

The mean cost per episode was significantly related to duration of episode (Figure 7-7); costs were lowest in the longer episodes. This may have been due to inclusion of a disproportionate number of episodes beginning in 1972-1973 in the set of episodes lasting less than two years, causing some effect of the post-1971 shift in treatment modes to show up as high resource use rates for short episodes. Another reason may have been more intensive therapy during the patient's first two years of care than later in the episode. Duration of episode explained 24.5 percent of the total variation in costs per episode.

Mean costs per episode were significantly related to the proportion of contacts in the episode for which hypertension was the presenting morbidity (Figure 7-8). This predictor explained 22.8 percent of the total variation in costs. This

relationship was more likely to be a result of the design of the data system rather than the severity of hypertension.

"New" episodes had significantly higher costs than did "continuing" episodes (Table 7-42). However, a "new" patient may have been previously treated outside the Health Plan.

The following patient variables were not significantly related with costs per episode:

- -- sex.
- -- subscriber unit or family size at index contact.
- -- diagnosis at index contact tentative rather than established.
- -- presence of one or more 'tentative' or 'unknown' diagnoses in the entire episode.
- -- presence of symptoms at the index contact.

2. Provider Characteristics

Episodes which included one or more nonphysician providers had significantly different (higher) costs per year than did episodes without nonphysician contacts (Table 7-43). Nonphysician providers included registered nurses, home health aides, and physician assistants.

The following provider-related variables were not significantly related to costs:

- -- whether care was given entirely by internists, or by a combination of internists and other specialties.
- -- physician specialty, internist or not, at index contact.

-- physician status at index contact: regular attending, temporary attending, or consultant.

-- presence or absence of a visit to a consultant at any point in the episode.

-- individual physician visited at index contact.

3. Medical Care Process Characteristics

The 21 patients whose episodes included one or more contacts at which they were ineligible for Health Plan coverage had significantly different (higher) costs per year than did patients eligible at all contacts (Table 7-44).

The following variables were not significantly correlated with mean dollar cost per episode year:

-- whether walk-in contacts were or were not present within the episode, or at the index contact.

-- whether contacts outside of regular medical office hours were or were not present within the episode, or at the index contact.

-- whether or not the patient had been eligible for Health Plan coverage in all 12 months of the year of the index contact, or whether the eligibility covered a shorter time.

4. Selected Utilization Measures

Figure 7-9 shows, as expected, that costs per year increased steadily with the number of medical office contacts per year. Variation in the rate of medical office contacts accounted for 53 percent of the variation in costs per episode. Variation in the rate of follow-up office visits per

year (medical office contacts in which hypertension was the presenting morbidity) explained 65 percent of the total variation in costs (Figure 7-10). The higher the rate of office visits per year, the higher the cost per episode per year.

The number of physical examinations per year was significantly related to costs (Figure 7-11). As the number of physical examinations per year increased, so did the costs per year. The number of physical examinations per year explained 10.3 percent of the variation in costs per year. Costs per year for hypertension episodes decreased with an increase in the proportion of contacts within an episode that were physical examinations (Figure 7-12). This probably results from the fact that hypertension occurring at physical examinations was less likely to be severe and because such office visits may also have been charged to the physical examination.

Episode costs per year increased with an increase in the number of laboratory tests ordered per year; variation in the number of laboratory tests per year explained 60 percent of the variation in costs per year (Figure 7-13). Episodes with one or more radiology procedures had significantly higher costs than episodes without any such procedures (Table 7-45). This explained 14 percent of the total variation in episode costs per year.

For episodes beginning in 1972 and 1973, costs per episode were significantly higher for those with one or more drug orders than for those without such orders (Table 7-46).

This explained 14 percent of the total variation in cost per episode year.

Episode costs where the provider (at the index contact) asked the patient to return for further care were significantly higher than episodes without such a request, although all episodes included at least three contacts (Table 7-47).

These data have shown that more medical office contacts and office visits for hypertension per year, more laboratory tests per year, the presence of a radiology procedure, and the presence of drug orders are associated with higher episode costs per year. The tendency of resource use to increase with these utilization measures suggests that these procedures are complementary, not substitutes in the care of hypertension.

The following utilization measures were not significantly related to annual outpatient episode costs:

-- presence or absence of a contact involving hospitalization.

-- presence or absence of any emergency room contacts within the episode.

-- presence or absence of any telephone or letter contacts within the episode.

B. Initial Six Month Workup Period

This section examines how patient, medical care process, and provider characteristics at the index contact affected the cost of care during the initial six months of the hypertension episodes.

1. Patient Characteristics

Patient age was significantly related to costs (Figure 7-14). The mean workup cost for patients under 35 years was triple that for those over 65. Variation in workup costs was twice as great for those under 35 as for those age 50-64. This pattern is similar to the relationship found between age at index contact and costs per episode year.

There is a significant relationship between workup cost and year of index contact (Figure 7-15). Year of index contact explained 8.5 percent of variation in workup costs, less than the proportion of variation explained in episode costs per year. The pattern of increasing resource use rates in later years was similar to the entire episode pattern.

Workup costs for hypertension were highest when hypertension was the presenting morbidity at the index contact (Figure 7-16). Costs were lower if hypertension was the first associated morbidity, and still less if hypertension was the second through sixth associated morbidity. This pattern was similar to that for the entire episode, and appeared to reflect the coding of procedures to presenting, not associated, morbidities.

Figures 7-17 and 7-18 show the effect of comorbidities at the index contact on workup period costs. Episodes with cardiovascular disease had lower costs charged to hypertension than "clean" episodes, those without obesity, diabetes, or cardiovascular disease. However, "clean" episodes and those with cardiovascular disease had similar mean numbers of

medical office contacts. Lower workup dollar charges for hypertensives with cardiovascular disease appeared to reflect the coding of office visits and diagnostic procedures to cardiovascular disease rather than to hypertension. Patients with obesity and without cardiovascular disease or diabetes had significantly lower workup costs and numbers of medical office contacts than "clean" episodes. This indicated that a finding of lower resource use for obese hypertensives was not an artifact. The same was true for the effect of obesity on entire-episode costs.

Subscriber unit size and age had a significant Pearson correlation of -.49 with workup period costs (Figure 7-19). Presumably, the effect on workup costs of large subscriber unit size was largely due to higher workup costs for hypertensives under 50 years of age--the group most likely to have multiple dependents enrolled in the Health Plan. For the entire episode, subscriber unit size had no effect on cost.

Mean dollar costs per episode were significantly different on the basis of symptoms at the index contact (Table 7-48). However, the number of episodes with symptoms at the index contact were few, and such symptoms did not affect the costs over the entire episode.

New episodes had significantly higher costs in the workup period than did continuing episodes (Table 7-49). A similar pattern existed for the entire episode.

The sex of the patient and the diagnosis status (tentative or established) at the index contact were not significantly related to costs in the workup period.

2. Provider and Medical Care Process Characteristics

The type of appointment at the index contact was significantly related to workup period costs (Figure 7-20). Episodes in which the initial contact was a walk-in medical office visit had more costly hypertension workups than those with a regularly-scheduled office contact, or a contact in the emergency room, or a contact by phone or letter. Presence or absence of walk-in contacts did not affect costs over the entire episode.

Health Plan eligibility at the index contact significantly affected workup costs (Table 7-50). Episodes beginning with a contact where the patient was ineligible had more costly workups than those who were eligible for Health Plan coverage. This was similar to the pattern of higher annual costs for the entire episode for patients who were ineligible for Health Plan coverage at any episode contact.

The following medical care process characteristics were not significantly related with the cost of workups:

-- Whether the index contact occurred within or outside regular medical office hours.

-- Whether, in the year of the index contact, the patient was eligible for Health Plan coverage over the entire calendar year, or for 11 or fewer months out of that calendar year.

The following provider characteristics at the index contact were not significantly correlated with the cost of initial workups:

-- Whether the provider was a physician or not.

-- Whether or not the provider was an internist.

-- Whether the provider was a regular attending physician, a temporary attending physician, or a consultant.

-- The identity of the provider.

Patients who were requested to return for further care received more costly workups than those who did not receive such instructions (Table 7-51). This difference was significant and accounted for 10.4 percent of the total variation in workup costs.

IX. KEY FINDINGS FROM BIVARIATE ANALYSIS

1. The cost of the initial workup and the cost per year over the entire episode declined with increased patient age at the index contact.

2. Little of the variation in costs was explained by comorbidities. Over the entire episode, episodes with adverse drug reactions had higher rates of resource use than those without such diagnoses; those with obesity as a comorbidity used lower costs than those without obesity, diabetes, or cardiovascular disease. The presence of obesity as a comorbidity at the index contact was associated with lower costs for the workup period.

3. Episodes that began in 1971 or later had higher annual costs of care; the cost of the initial workup period increased from 1966 through 1973.

4. Sex did not effect costs, either during the workup period or for the entire episode.

5. New episodes had higher annual costs, and higher costs for initial workups, than did continuing episodes.

6. Episodes with one or more contacts with a nonphysician provider had higher annual costs than episodes with only physician contacts. Physician specialty, identity, and status did not affect costs in the workup period or over the entire episode.

7. The presence of "unknown" or "tentative" diagnoses within the episode did not affect costs for the workup period or the entire episode.

8. Patients with symptoms at the index contact had higher workup period costs than others, but had similar annual costs over the whole episode.

9. Patients who were ineligible for Health Plan coverage at their index contact or at any time in the episode had higher costs, both in the workup period and over the entire episode.

10. Higher annual rates of medical office contacts, office visits coded to hypertension, laboratory tests, and radiology procedures were strongly related to higher annual dollar costs. Episodes with drug orders had higher costs per

year than those without drug orders. Most procedures appear to be complementary, not substitutes for each other in the care of hypertension.

11. The presence of hospitalizations, emergency room contacts, telephone calls and letters, or contacts outside of regular medical office hours did not affect outpatient costs.

12. Episodes requested to return for further care had higher costs for the workup period, and higher annual costs, than those without such a request.

X. MULTIVARIATE ANALYSIS

This analysis identified the combinations of specific components of utilization (office visits, laboratory and radiology procedures, hospitalizations, telephone calls, etc.) which best accounted for variation in dollar cost per year and dollar cost during the first six months of the episode. This procedure was also used to define the combinations of patient, provider, and medical care process characteristics which best accounted for variation in resource use.

1. All 465 Hypertension Episodes

a. Utilization

The dependent variable for the first AID analysis was dollar costs per episode-year. Predictor variables are shown in Table 7-52; the analysis results are shown in Figure 7-21. Different combinations of (1) followup office visits per year, (2) intravenous urographies (IVUs), and (3) sodium tests accounted for 69.6 percent of the variation in episode costs.

Nine bundles of care were defined. The least costly (mean $5.53 per year) did not include IVUs, and office visits with hypertension as the presenting morbidity occurred less frequently than once every year. The most costly bundle (mean $80.50 per year) included six or more followup office visits per year.

Table 7-53 examines whether higher-cost bundles represented more intensive provision of the same types of care that were provided in lower-cost bundles, or whether higher-cost bundles were associated with a qualitatively different method of care. Higher-cost bundles, 4 through 9, received more laboratory tests for hypertension than did the lower-cost bundles, 1 and 2. Episodes in bundle 3 received a mean of 6.0 laboratory tests per episode, more than for any other bundle. Multiple laboratory tests may have been used to monitor electrolyte balance.

The number of chest x-rays and intravenous urographies (IVUs) increased as the overall bundle cost increased, with the greatest numbers of these in the two bundles that were defined by the presence of an IVU. The lowest-cost bundle included the smallest mean number of drug orders per bundle. The number of follow-up office visits per year increased with bundle cost. Bundle 5 included those who had an IVU with less than two follow-up office visits per year; the presence of an IVU might not indicate serious illness requiring many office visits per year.

b. Patient/Provider/Medical Care Process

This analysis, using dollars per episode-year as the dependent variable, examines how different combinations of patient, provider, and medical care process variables influence the intensity of resource use. Predictor variables included are presented in Table 7-54; the analysis results are shown in Figure 7-22. These variables accounted for 36.7 percent of the variation in dollar use per episode year: (1) year of index contact, (2) proportion of contacts in episode in which a physical examination was done, (3) age at index contact, (4) presence or absence of a tentative or unknown diagnosis in the episode, (5) presence or absence of a walk-in contact in the episode, and (6) comorbidity group. Year of index contact was the most important single variable; the dichotomy between episodes beginning in 1972 or 1973 and those beginning in 1971 or earlier explained 21.4 percent of total variation in cost per episode year. The cost of caring for episodes of hypertension increased substantially in 1972 and 1973. Costs for the younger patients tended to be higher than those for older patients. Costs were higher for those with walk-in medical office contacts than for those without such contacts. Costs were higher for those episodes with uncertain diagnoses (one or more tentative diagnoses) than for those in which all contacts involved an established diagnosis of hypertension.

Costs were lower for episodes that began before 1972, for whom at least 25 percent of episode contacts were physical

examinations. There was too little variation in cost per year to further subdivide these episodes. This, along with an inverse relationship (r=-.37) between the number of medical office visits per year and the proportion of contacts that were physical examinations, suggests that the lowest-cost episodes were composed of those in which followup care included an annual or biannual physical examination. The highest-cost episodes (mean $57.17 per episode) were those beginning in 1972 or 1973, with patient age under 50 or over 74.

Episode duration was not included in the analyses; the high negative correlation between year of index contact and episode duration suggested that most variation in duration was an artifact of the truncation of follow-up on December 31, 1973.

2. 313 "New" Hypertension Episodes

a. Utilization

This analysis identified the combinations of specific components of medical care utilization which best predicted variation in cost for the initial six months of a newly-diagnosed episode of hypertension. (The 313 episodes defined as "new" were not necessarily all newly-diagnosed, but the 152 known continuing, previouslydiagnosed episodes were excluded.

Variables used in this analysis are listed in Table 7-55. Figure 7-23 shows that 79.6 percent of total variation in workup period resource use was explained by combinations of

(1) intravenous urographies, (2) electrolyte tests (sodium, potassium, or phosphorus), (3) initial office visits, and (4) follow-up office visits for hypertension. The presence or absence of an intravenous urography was the variable that explained the largest proportion of variation in workup costs, 47.8 percent. The lowest cost bundle of care (mean $1.68 per episode) included those without any intravenous urographies or office visits charged to hypertension. The most costly workup (mean $68.23) included one or more intravenous urographies, and two or more electrolyte tests.

Table 7-56 examines whether higher-cost workup bundles of care included more intensive services similar to those used in lower-cost bundles, or whether higher-cost bundles involved a qualitatively different type of workup. The lowest-cost bundle included fewer drug orders than the other bundles. The number of laboratory tests and radiology procedures increased with bundle cost; the highest-cost bundles, 6 through 9, were defined by the provision of these services. Likewise, the number of follow-up office visits increased with bundle cost. Figure 23 shows that the bundles of care changed in character with increasing costs. The lowest-cost bundles included few electrolyte tests; medium-cost bundles (6 and 7) included electrolyte tests without an IVU; the highest-cost bundles included an IVU.

b. Patient, Provider, and Medical Care Process

Variables used in this analysis are listed in Table 7-57; the results of the analysis are shown in Figure 7-24. This

analysis examines the extent to which patient, provider, and medical care process characteristics at the index contact predicted workup costs for new hypertension episodes. Altogether, 29.8 percent of variation in costs was explained by combinations of these characteristics: (1) presence or absence of a physician request that the patient return for further diagnosis, monitoring, or therapy, (2) presence or absence of comorbid conditions, (3) patient age, (4) year of index contact, (5) subscriber unit size, and (6) presence or absence of a physical examination at the index contact. Patients with no return ordered at the index contact had the least expensive workups (mean $7.42), while those with a return order, without comorbidities medically related to hypertension, and under 35 or over 74 years of age had the most costly workups (mean $48.26).

The presence or absence of a request to return explained 10.9 percent of a variation in workup costs. It did not determine whether the patient returned for care, since all episodes by definition contained at least three medical office contacts. This variable may have been a proxy for whether the physician ordered an immediate workup; it may have separated the 313 "new" cases into newly-diagnosed hypertensives and those whose hypertension had been diagnosed and stabilized outside the Health Plan. Patients without cardiovascular disease, diabetes, or obesity at the index contact had costlier workups charged to hypertension than those with

comorbidities. Workup costs were higher for episodes beginning after 1970 than for those beginning in 1970 or earlier. Younger patients had more costly workups for hypertension. It appeared that once the physician decided to request that a new hypertension patient return for further care, the workup costs were determined primarily by patient characteristics.

3. Summary

Patterns of care for the workup and the whole episode were primarily defined by the number of office visits charged to hypertension, the number of electrolyte tests, and the presence or absence of an intravenous urography. There was a wide range of costs and over the entire episode, costlier bundles of care appeared to be more intense applications of the types of services given in lower-cost bundles. During the workup period, higher cost bundles were more likely than lower-cost bundles to have IVUs and electrolyte tests.

Patient, provider, and medical care process variables explained 30 percent of variation in workup cost, and 37 percent of variation in total costs per episode year. Provider characteristics and patient Health Plan eligibility had little effect on costs. Important patient variables were age and year of index contact (which may be an indicator of a shift toward more intensive therapy for hypertensives in the 1970 .) The effects of comorbid conditions on utilization appeared to be primarily an artifact of the coding procedures.

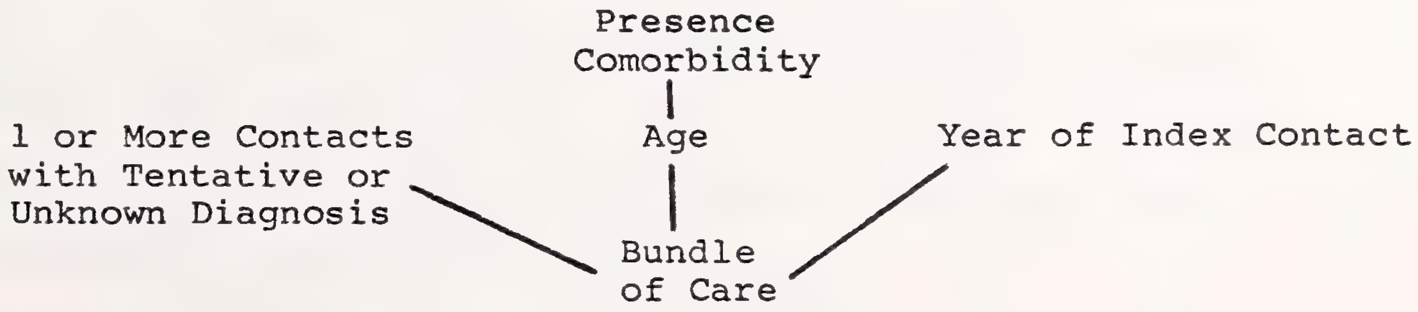
Key medical care process variables were the proportion of contacts which were physical examinations (total episode costs) and the presence of instructions to return for further care (workup period costs).

B. Log-linear Multiway Contingency Analysis

Using the models and bundles identified in the AID analyses, it was possible to identify the relative importance of two-factor and higher order interactions, and test the fit of each given model to the data. In this analysis, the nine bundles of care for all 465 hypertension episodes were treated as a single variable with nine possible choices. The patient, provider, and medical care process variables were entered in an effort to determine which were associated with one or more of the bundles of care. Table 7-58 presents the different bundles of care for all episodes and for new episodes.

The model for all episodes:

Diagrammed below is the pattern of interrelationships among all examined variables which determined the choice of treatment bundles for the entire episode. Only interactions significant at the $p \leq .05$ level were included.



Two other medical care process variables appeared to be related to bundle of care in the AID analysis: presence or absence of a walk-in contact in the episode and whether or not at least 25 percent of the episode contacts were physical exams. However, neither variable was significantly related to bundle of care using the LLMCA.

The model shows that the year of the index contact, patient age, and the presence of contacts within the episode with a tentative or unknown diagnosis were significantly, directly related to the choice of bundle of care. The presence of comorbid conditions was not directly related to bundle of care.

Table 7-59 lists all significant relationships of the bundle of care with the three variables that significantly influenced the choice of bundle of care. The least expensive bundle, characterized by no IVUs and an office visit less than once a year, was more likely to be used in episodes beginning in 1966-1968, and less likely to be used in episodes beginning in 1972 or 1973. Episodes with one or more contacts with a tentative or unknown diagnosis were considerably less likely to receive the lowest cost bundle of care than were those in which all contacts had an established diagnosis. Bundles 1 and 2 (lower cost) were more likely to be found among those between 50 and 74 years of age; bundle 1 was less likely to be found among those over 75 years of age.

There were several significant two-way interactions between variables used to determine the bundle of care chosen.

These are listed below, along with log parameter standard error, (beta values), and p values.

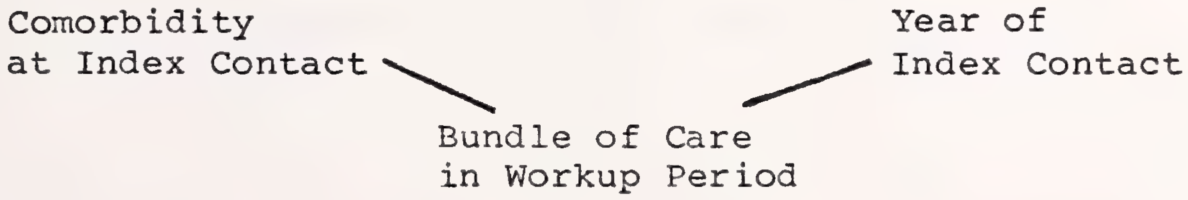
1. Episodes involving persons aged 50-74 were more likely than other age groups to have received their diagnosis of hypertension in 1966-68, 2.114 (1.110), $p \leq .05$.

2. Episodes of hypertension with cardiovascular disease as a comorbidity were less likely to involve persons under 50 years of age, -2.581 (.848), $p \leq .01$, and more likely to involve persons 50-74 years old, 2.034, (1.132), $p \leq .05$. Episodes with diabetes and without cardiovascular comorbidities were less likely to be 50-74 years of age, -2.098 (.876), $p \leq .05$.

3. Episodes with a tentative or unknown diagnosis of hypertension during the episode were more likely to be over 75 years of age, 2.337 (1.092), $p \leq .05$, and less likely to be between 50 and 74 years of age, -3.913 (.871), $p \leq .01$.

The model for new episodes:

Examined below is the LLMCA model which shows relationships between the choice of the bundle of care used for the first six months of new episodes and the patient, provider, and medical care process variables identified by the AID analysis. Only interactions significant at the $p \leq .05$ level are included.



These additional predictor variables appeared to be related to bundle of care from the AID analysis, but did not contribute significant interaction to the LLMCA model: presence or absence of instructions at the index contact to return for further care; patient age at index contact, subscriber unit size at index contact; and whether or not the index contact was a physical examination.

The above model indicates that the initial workup for new episodes was influenced by the year of index contact and by the presence or absence of cardiovascular disease, diabetes, or obesity. Table 7-60 examines these relationships in detail. It shows that episodes with cardiovascular disease, diabetes, or obesity were more likely to receive the least costly bundle of care than are those without these comorbidities. This result was probably an artifact of the coding system; the initial and follow-up office visits, intravenous urographies, and electrolyte tests which defined workup period bundles may well have been coded to a comorbidity. The other finding, that the least cost bundle was much more likely to be given to episodes beginning in 1966-1970 than to those beginning in 1971-1973, was consistent with earlier findings that intensity of care of hypertension increased during and after 1971. There were no other significant interactions for this group of episodes.

XI. CONCLUSIONS

A. Episode Definition

Each hypertension episode was defined as including all contacts with the Health Plan in which hypertension was either a comorbidity or the presenting morbidity and all contacts in which adverse effects of antihypertensive therapy was the presenting morbidity. Further, each episode had: (1) an established diagnosis of hypertension at least once in the episode, (2) three or more medical office contacts at which hypertension was diagnosed, and (3) at least six months duration between the patient's first and last contact for hypertension or adverse drug reactions. During the episode, few patients sought care outside the Health Plan. Few had gaps in Health Plan eligibility between the first and last contacts, even for episodes lasting two to seven years. Thus, this episode definition was an attempt to generate complete and clinically established episodes of care for hypertension within the Health Plan.

The tendency of physicians to assign a diagnosis of hypertension and to initiate therapy probably changed considerably over the study period as a result of an important research finding. At the start of the study period, patients with mild to moderate blood pressure elevation tended not to receive therapy. In 1970, the results of a five-year Veterans Administration study were published,[6] suggesting that all patients with diastolic blood pressure of 104 or more should be treated; treatment of those with diastolic blood pressures

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[6] Op Cit.

of 90 to 103 could be left to the physician's discretion. From 1970 onward, these results were widely published, causing physicians to treat hypertension more aggressively.

Hypertension is normally a symptomless disease; only one-fourth of the episodes began with hypertension as the primary reason for the patient's contact. Hypertension frequently appeared in combination with obesity, diabetes, or cardiovascular disease. In such episodes, the charging of procedures and costs to hypertension or to a coexisting illness could be arbitrary. Another problem was absence of blood pressure readings from computerized data, complicating the measurement of outcome and stratification of episodes by the severity of hypertension. Data were not available to indicate changes in the severity of comorbidities, such as progression from mild to severe obesity, or from mild to uncontrolled diabetes.

B. Resource Use and Bundle Definition

For the entire episode of care, nine different bundles of care were identified. The variation among the bundles explained 70 percent of the variation in costs of care per episode year. Over the entire episode, the costlier bundles of care appeared to involve more office visits, more radiology procedures, more laboratory tests, and more drug orders than were given in lower cost bundles; the difference was quantitative, not qualitative. Office visits, drug orders, and diagnostic procedures were used complementary to, not as substitutes for, each other. The care given for hypertension

usually included one to five medical office contacts per year (including one physical examination annually), one to three laboratory tests per year (including a potassium test), and an order for diuretics. The factors influencing physicians to order intravenous urographies for hypertension deserve further study, due to the substantial cost of the procedure.

Bundles of care for the diagnostic workup period, the initial six months of the episode, were defined by the presence or absence of intravenous urographies, electrolyte tests, and office visits with hypertension as the presenting morbidity. The lower-cost workup bundles included few office visits without electrolyte tests; middle-cost bundles included more office visits with or without electrolyte tests; the higher-cost bundles included intravenous urographies. Utilization rates were higher for the initial six months of the episode than over the entire episode.

C. Effect of Patient, Provider, and Medical Care Process Characteristics on Utilization

The key findings were:

1. Over the entire episode and during the workup period, increased patient age at the index contact was associated with lower costs.

2. Patients with hypertension and obesity had lower costs in the workup period and the entire episode than those with hypertension unaccompanied by obesity, diabetes, or cardiovascular disease. Episodes with adverse drug reactions had

higher costs than those without such reactions. These were the only instances in which comorbidities had a real effect on costs for hypertension; other comorbidity effects were artifacts of the coding process.

3. Workup costs and entire episode costs were higher in episodes beginning in 1971 and later than in those beginning in 1970 or earlier.

4. Costs were greater during the initial six months after diagnosis than later in the episode.

5. Patient sex and the specialty or status of the physicians visited did not affect costs.

6. The presence of hospitalizations or emergency room contacts did not affect costs of care.

7. Costs were greater in episodes for which there was uncertainty about the hypertension diagnosis.

In summary, costs were influenced primarily by the characteristics of the patient and by profession-wide changes in standards for treating or not treating hypertensives. Neither appears readily susceptible to cost-reducing policy changes.

D. Implication for Further Research

While certain conclusions have been drawn with respect to the determinants of the costs of caring for episodes of hypertension, additional data, were it available, could significantly improve understanding of how resources are used. Some of these data are more, some less, obtainable.

Generally, the following kinds of information would be helpful:

1. Blood pressure determinations over time.

2. Objectives (goals) of health care provided (i.e., drugs alone, weight control, exercise, or other behavioral changes).

3. Length and content of office visits.

4. Changes in weight/height ratio.

5. Overlapping services charged to other morbidities but of primary use to the care of hypertension.

6. Drug costs (whether to the Health Plan or to the patient).

7. Changes in severity of comorbid conditions which might influence the costs of caring for hypertension.

8. Sufficient numbers of episodes managed by individual physicians to obtain accurate information on the level of interphysician differences in treating hypertension.

Nine bundles of care were defined. The least costly (mean $5.53 per year) did not include IVUs, and office visits with hypertension as the presenting morbidity occurred less frequently than once every year. The most costly bundle (mean $80.50 per year) included six or more followup office visits per year.

Table 7-53 examines whether higher-cost bundles represented more intensive provision of the same types of care that were provided in lower-cost bundles, or whether higher-cost bundles were associated with a qualitatively different method of care. Higher-cost bundles, 4 through 9, received more laboratory tests for hypertension than did the lower-cost bundles, 1 and 2. Episodes in bundle 3 received a mean of 6.0 laboratory tests per episode, more than for any other bundle. Multiple laboratory tests may have been used to monitor electrolyte balance.

The number of chest x-rays and intravenous urographies (IVUs) increased as the overall bundle cost increased, with the greatest numbers of these in the two bundles that were defined by the presence of an IVU. The lowest-cost bundle included the smallest mean number of drug orders per bundle. The number of follow-up office visits per year increased with bundle cost. Bundle 5 included those who had an IVU with less than two follow-up office visits per year; the presence of an IVU might not indicate serious illness requiring many office visits per year.

b. Patient/Provider/Medical Care Process

This analysis, using dollars per episode-year as the dependent variable, examines how different combinations of patient, provider, and medical care process variables influence the intensity of resource use. Predictor variables included are presented in Table 7-54; the analysis results are shown in Figure 7-22. These variables accounted for 36.7 percent of the variation in dollar use per episode year: (1) year of index contact, (2) proportion of contacts in episode in which a physical examination was done, (3) age at index contact, (4) presence or absence of a tentative or unknown diagnosis in the episode, (5) presence or absence of a walk-in contact in the episode, and (6) comorbidity group. Year of index contact was the most important single variable; the dichotomy between episodes beginning in 1972 or 1973 and those beginning in 1971 or earlier explained 21.4 percent of total variation in cost per episode year. The cost of caring for episodes of hypertension increased substantially in 1972 and 1973. Costs for the younger patients tended to be higher than those for older patients. Costs were higher for those with walk-in medical office contacts than for those without such contacts. Costs were higher for those episodes with uncertain diagnoses (one or more tentative diagnoses) than for those in which all contacts involved an established diagnosis of hypertension.

Costs were lower for episodes that began before 1972, for whom at least 25 percent of episode contacts were physical

examinations. There was too little variation in cost per year to further subdivide these episodes. This, along with an inverse relationship (r=-.37) between the number of medical office visits per year and the proportion of contacts that were physical examinations, suggests that the lowest-cost episodes were composed of those in which followup care included an annual or biannual physical examination. The highest-cost episodes (mean $57.17 per episode) were those beginning in 1972 or 1973, with patient age under 50 or over 74.

Episode duration was not included in the analyses; the high negative correlation between year of index contact and episode duration suggested that most variation in duration was an artifact of the truncation of follow-up on December 31, 1973.

2. 313 "New" Hypertension Episodes

a. Utilization

This analysis identified the combinations of specific components of medical care utilization which best predicted variation in cost for the initial six months of a newly-diagnosed episode of hypertension. (The 313 episodes defined as "new" were not necessarily all newly-diagnosed, but the 152 known continuing, previouslydiagnosed episodes were excluded.

Variables used in this analysis are listed in Table 7-55. Figure 7-23 shows that 79.6 percent of total variation in workup period resource use was explained by combinations of

(1) intravenous urographies, (2) electrolyte tests (sodium, potassium, or phosphorus), (3) initial office visits, and (4) follow-up office visits for hypertension. The presence or absence of an intravenous urography was the variable that explained the largest proportion of variation in workup costs, 47.8 percent. The lowest cost bundle of care (mean $1.68 per episode) included those without any intravenous urographies or office visits charged to hypertension. The most costly workup (mean $68.23) included one or more intravenous urographies, and two or more electrolyte tests.

Table 7-56 examines whether higher-cost workup bundles of care included more intensive services similar to those used in lower-cost bundles, or whether higher-cost bundles involved a qualitatively different type of workup. The lowest-cost bundle included fewer drug orders than the other bundles. The number of laboratory tests and radiology procedures increased with bundle cost; the highest-cost bundles, 6 through 9, were defined by the provision of these services. Likewise, the number of follow-up office visits increased with bundle cost. Figure 23 shows that the bundles of care changed in character with increasing costs. The lowest-cost bundles included few electrolyte tests; medium-cost bundles (6 and 7) included electrolyte tests without an IVU; the highest-cost bundles included an IVU.

b. Patient, Provider, and Medical Care Process

Variables used in this analysis are listed in Table 7-57; the results of the analysis are shown in Figure 7-24. This

analysis examines the extent to which patient, provider, and medical care process characteristics at the index contact predicted workup costs for new hypertension episodes. Altogether, 29.8 percent of variation in costs was explained by combinations of these characteristics: (1) presence or absence of a physician request that the patient return for further diagnosis, monitoring, or therapy, (2) presence or absence of comorbid conditions, (3) patient age, (4) year of index contact, (5) subscriber unit size, and (6) presence or absence of a physical examination at the index contact. Patients with no return ordered at the index contact had the least expensive workups (mean $7.42), while those with a return order, without comorbidities medically related to hypertension, and under 35 or over 74 years of age had the most costly workups (mean $48.26).

The presence or absence of a request to return explained 10.9 percent of a variation in workup costs. It did not determine whether the patient returned for care, since all episodes by definition contained at least three medical office contacts. This variable may have been a proxy for whether the physician ordered an immediate workup; it may have separated the 313 "new" cases into newly-diagnosed hypertensives and those whose hypertension had been diagnosed and stabilized outside the Health Plan. Patients without cardiovascular disease, diabetes, or obesity at the index contact had costlier workups charged to hypertension than those with

comorbidities. Workup costs were higher for episodes beginning after 1970 than for those beginning in 1970 or earlier. Younger patients had more costly workups for hypertension. It appeared that once the physician decided to request that a new hypertension patient return for further care, the workup costs were determined primarily by patient characteristics.

3. Summary

Patterns of care for the workup and the whole episode were primarily defined by the number of office visits charged to hypertension, the number of electrolyte tests, and the presence or absence of an intravenous urography. There was a wide range of costs and over the entire episode, costlier bundles of care appeared to be more intense applications of the types of services given in lower-cost bundles. During the workup period, higher cost bundles were more likely than lower-cost bundles to have IVUs and electrolyte tests.

Patient, provider, and medical care process variables explained 30 percent of variation in workup cost, and 37 percent of variation in total costs per episode year. Provider characteristics and patient Health Plan eligibility had little effect on costs. Important patient variables were age and year of index contact (which may be an indicator of a shift toward more intensive therapy for hypertensives in the 1970 .) The effects of comorbid conditions on utilization appeared to be primarily an artifact of the coding procedures.

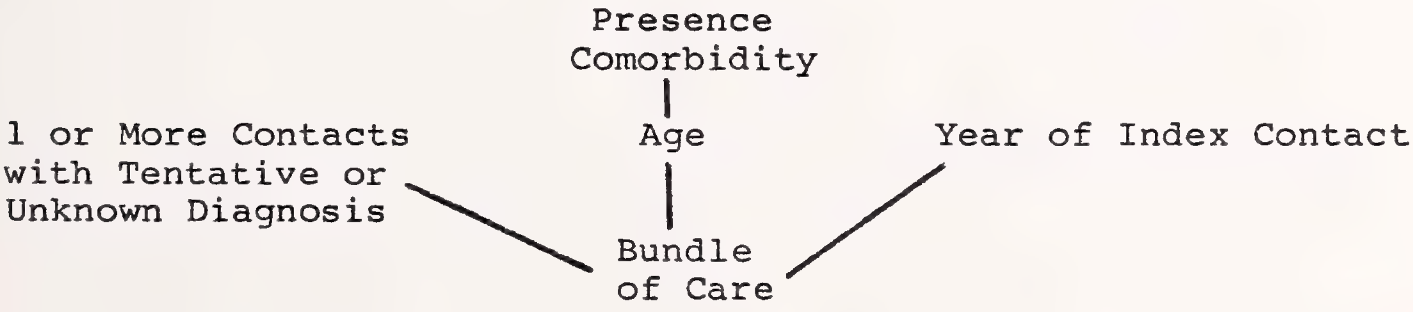
Key medical care process variables were the proportion of contacts which were physical examinations (total episode costs) and the presence of instructions to return for further care (workup period costs).

B. Log-linear Multiway Contingency Analysis

Using the models and bundles identified in the AID analyses, it was possible to identify the relative importance of two-factor and higher order interactions, and test the fit of each given model to the data. In this analysis, the nine bundles of care for all 465 hypertension episodes were treated as a single variable with nine possible choices. The patient, provider, and medical care process variables were entered in an effort to determine which were associated with one or more of the bundles of care. Table 7-58 presents the different bundles of care for all episodes and for new episodes.

The model for all episodes:

Diagrammed below is the pattern of interrelationships among all examined variables which determined the choice of treatment bundles for the entire episode. Only interactions significant at the $p \leq .05$ level were included.



Two other medical care process variables appeared to be related to bundle of care in the AID analysis: presence or absence of a walk-in contact in the episode and whether or not at least 25 percent of the episode contacts were physical exams. However, neither variable was significantly related to bundle of care using the LLMCA.

The model shows that the year of the index contact, patient age, and the presence of contacts within the episode with a tentative or unknown diagnosis were significantly, directly related to the choice of bundle of care. The presence of comorbid conditions was not directly related to bundle of care.

Table 7-59 lists all significant relationships of the bundle of care with the three variables that significantly influenced the choice of bundle of care. The least expensive bundle, characterized by no IVUs and an office visit less than once a year, was more likely to be used in episodes beginning in 1966-1968, and less likely to be used in episodes beginning in 1972 or 1973. Episodes with one or more contacts with a tentative or unknown diagnosis were considerably less likely to receive the lowest cost bundle of care than were those in which all contacts had an established diagnosis. Bundles 1 and 2 (lower cost) were more likely to be found among those between 50 and 74 years of age; bundle 1 was less likely to be found among those over 75 years of age.

There were several significant two-way interactions between variables used to determine the bundle of care chosen.

These are listed below, along with log parameter standard error, (beta values), and p values.

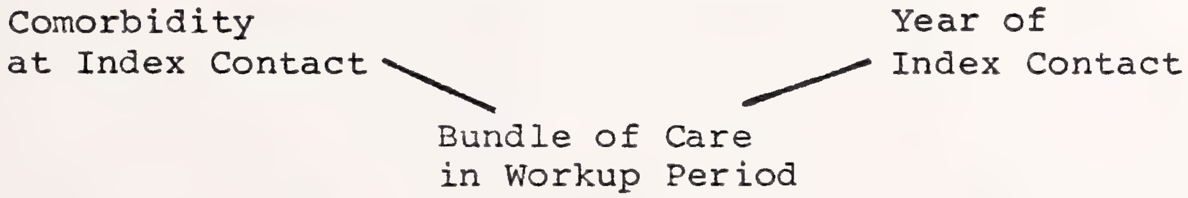
1. Episodes involving persons aged 50-74 were more likely than other age groups to have received their diagnosis of hypertension in 1966-68, 2.114 (1.110), $p \leq .05$.

2. Episodes of hypertension with cardiovascular disease as a comorbidity were less likely to involve persons under 50 years of age, -2.581 (.848), $p \leq .01$, and more likely to involve persons 50-74 years old, 2.034, (1.132), $p \leq .05$. Episodes with diabetes and without cardiovascular comorbidities were less likely to be 50-74 years of age, -2.098 (.876), $p \leq .05$.

3. Episodes with a tentative or unknown diagnosis of hypertension during the episode were more likely to be over 75 years of age, 2.337 (1.092), $p \leq .05$, and less likely to be between 50 and 74 years of age, -3.913 (.871), $p \leq .01$.

The model for new episodes:

Examined below is the LLMCA model which shows relationships between the choice of the bundle of care used for the first six months of new episodes and the patient, provider, and medical care process variables identified by the AID analysis. Only interactions significant at the $p \leq .05$ level are included.



These additional predictor variables appeared to be related to bundle of care from the AID analysis, but did not contribute significant interaction to the LLMCA model: presence or absence of instructions at the index contact to return for further care; patient age at index contact, subscriber unit size at index contact; and whether or not the index contact was a physical examination.

The above model indicates that the initial workup for new episodes was influenced by the year of index contact and by the presence or absence of cardiovascular disease, diabetes, or obesity. Table 7-60 examines these relationships in detail. It shows that episodes with cardiovascular disease, diabetes, or obesity were more likely to receive the least costly bundle of care than are those without these comorbidities. This result was probably an artifact of the coding system; the initial and follow-up office visits, intravenous urographies, and electrolyte tests which defined workup period bundles may well have been coded to a comorbidity. The other finding, that the least cost bundle was much more likely to be given to episodes beginning in 1966-1970 than to those beginning in 1971-1973, was consistent with earlier findings that intensity of care of hypertension increased during and after 1971. There were no other significant interactions for this group of episodes.

XI. CONCLUSIONS

A. Episode Definition

Each hypertension episode was defined as including all contacts with the Health Plan in which hypertension was either a comorbidity or the presenting morbidity and all contacts in which adverse effects of antihypertensive therapy was the presenting morbidity. Further, each episode had: (1) an established diagnosis of hypertension at least once in the episode, (2) three or more medical office contacts at which hypertension was diagnosed, and (3) at least six months duration between the patient's first and last contact for hypertension or adverse drug reactions. During the episode, few patients sought care outside the Health Plan. Few had gaps in Health Plan eligibility between the first and last contacts, even for episodes lasting two to seven years. Thus, this episode definition was an attempt to generate complete and clinically established episodes of care for hypertension within the Health Plan.

The tendency of physicians to assign a diagnosis of hypertension and to initiate therapy probably changed considerably over the study period as a result of an important research finding. At the start of the study period, patients with mild to moderate blood pressure elevation tended not to receive therapy. In 1970, the results of a five-year Veterans Administration study were published,[6] suggesting that all patients with diastolic blood pressure of 104 or more should be treated; treatment of those with diastolic blood pressures

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[6] Op Cit.

of 90 to 103 could be left to the physician's discretion. From 1970 onward, these results were widely published, causing physicians to treat hypertension more aggressively.

Hypertension is normally a symptomless disease; only one-fourth of the episodes began with hypertension as the primary reason for the patient's contact. Hypertension frequently appeared in combination with obesity, diabetes, or cardiovascular disease. In such episodes, the charging of procedures and costs to hypertension or to a coexisting illness could be arbitrary. Another problem was absence of blood pressure readings from computerized data, complicating the measurement of outcome and stratification of episodes by the severity of hypertension. Data were not available to indicate changes in the severity of comorbidities, such as progression from mild to severe obesity, or from mild to uncontrolled diabetes.

B. Resource Use and Bundle Definition

For the entire episode of care, nine different bundles of care were identified. The variation among the bundles explained 70 percent of the variation in costs of care per episode year. Over the entire episode, the costlier bundles of care appeared to involve more office visits, more radiology procedures, more laboratory tests, and more drug orders than were given in lower cost bundles; the difference was quantitative, not qualitative. Office visits, drug orders, and diagnostic procedures were used complementary to, not as substitutes for, each other. The care given for hypertension

usually included one to five medical office contacts per year (including one physical examination annually), one to three laboratory tests per year (including a potassium test), and an order for diuretics. The factors influencing physicians to order intravenous urographies for hypertension deserve further study, due to the substantial cost of the procedure.

Bundles of care for the diagnostic workup period, the initial six months of the episode, were defined by the presence or absence of intravenous urographies, electrolyte tests, and office visits with hypertension as the presenting morbidity. The lower-cost workup bundles included few office visits without electrolyte tests; middle-cost bundles included more office visits with or without electrolyte tests; the higher-cost bundles included intravenous urographies. Utilization rates were higher for the initial six months of the episode than over the entire episode.

C. Effect of Patient, Provider, and Medical Care Process Characteristics on Utilization

The key findings were:

1. Over the entire episode and during the workup period, increased patient age at the index contact was associated with lower costs.

2. Patients with hypertension and obesity had lower costs in the workup period and the entire episode than those with hypertension unaccompanied by obesity, diabetes, or cardiovascular disease. Episodes with adverse drug reactions had

higher costs than those without such reactions. These were the only instances in which comorbidities had a real effect on costs for hypertension; other comorbidity effects were artifacts of the coding process.

3. Workup costs and entire episode costs were higher in episodes beginning in 1971 and later than in those beginning in 1970 or earlier.

4. Costs were greater during the initial six months after diagnosis than later in the episode.

5. Patient sex and the specialty or status of the physicians visited did not affect costs.

6. The presence of hospitalizations or emergency room contacts did not affect costs of care.

7. Costs were greater in episodes for which there was uncertainty about the hypertension diagnosis.

In summary, costs were influenced primarily by the characteristics of the patient and by profession-wide changes in standards for treating or not treating hypertensives. Neither appears readily susceptible to cost-reducing policy changes.

D. Implication for Further Research

While certain conclusions have been drawn with respect to the determinants of the costs of caring for episodes of hypertension, additional data, were it available, could significantly improve understanding of how resources are used. Some of these data are more, some less, obtainable.

Generally, the following kinds of information would be helpful:

1. Blood pressure determinations over time.

2. Objectives (goals) of health care provided (i.e., drugs alone, weight control, exercise, or other behavioral changes).

3. Length and content of office visits.

4. Changes in weight/height ratio.

5. Overlapping services charged to other morbidities but of primary use to the care of hypertension.

6. Drug costs (whether to the Health Plan or to the patient).

7. Changes in severity of comorbid conditions which might influence the costs of caring for hypertension.

8. Sufficient numbers of episodes managed by individual physicians to obtain accurate information on the level of interphysician differences in treating hypertension.

TABLE 7-1

NUMBER OF CONTACTS IN EPISODE WITH HYPERTENSION AS AN ESTABLISHED DIAGNOSIS

Number of Contacts	N of Episodes	Pct.
None	71	8.1
One	176	20.0
Two	104	11.8
Three or more	530	60.1
	881	100.0

TABLE 7-2

NUMBER OF MEDICAL OFFICE CONTACTS, ALL HYPERTENSION EPISODES

Number of Contacts	N of Episodes	Pct.
0	12	1.4
1	214	24.3
2	131	14.9
3-5	201	22.8
6-10	144	16.3
11-20	118	13.4
More than 20	61	6.9
	881	100.0

TABLE 7-3

DURATION, ALL HYPERTENSION EPISODES

Duration	N	Pct.
Single day	206	23.4
2-30 days	64	7.3
31-180 days	108	12.2
181-364 days	55	6.2
1 yr.-2.99 yrs.	171	19.5
3 yrs.-4.99 yrs.	127	14.4
5 yrs. or more	150	17.0
	881	100.0

TABLE 7-4

PROPORTION OF CONFIRMED AND UNCONFIRMED HYPERTENSION EPISODES WITH SELECTED UTILIZATION MEASURES

	Unconfirmed Episodes N=416		Confirmed Episodes N=465	
Utilization Measure	N	Pct.	N	Pct.
1 or more laboratory tests	116	27.9	341	73.3
1 or more x-rays	35	8.5	127	27.3
0 or 1 medical office contact	226	54.3	0	0
3 or more medical office contacts	59	14.2	465	100.0
No RVS units coded to episode	210	50.5	16	3.4
1 or more drugs ordered during episode*	61	27.7	57	87.7

*Data for episodes beginning in 1972 or 1973 only. 220 unconfirmed cases, and 65 confirmed episodes.

TABLE 7-5

INSTRUCTIONS AT INDEX CONTACT TO RETURN FOR CARE, FOR CONFIRMED AND UNCONFIRMED EPISODES OF HYPERTENSION

Instructions at Index Contact to Return to Physician

	Pct. No	Pct. Yes	Pct. All
Unconfirmed	50.2	49.8	100.0
Confirmed	51.2	48.8	100.0

Chi square $X^2=.045$, 1 df, $p=.83$
Contingency coefficient c.c=.009; gamma = -.02

Instructions at Index Contact to Return to Lab or X-ray

	Pct. No	Pct. Yes	Pct. All
Unconfirmed	78.1	21.9	100.0
Confirmed	73.3	26.7	100.0

Chi square $X^2=2.5$, 1 df, $p=.11$
Contingency coefficient c.c=.06; gamma = .13

Instructions at Index Contact to Return to Physician, Laboratory, X-ray, Hospital, or any Other Service

	Pct. No	Pct. Yes	Pct. All
Unconfirmed	39.9	60.1	100.0
Confirmed	38.9	61.1	100.0

Chi square $X^2=.05$, 1 df, $p=.82$
Contingency coefficient c.c=.01; gamma = .02

TABLE 7-6

INSTRUCTIONS TO RETURN FOR CARE, OVER ENTIRE EPISODE, FOR CONFIRMED AND UNCONFIRMED EPISODES OF HYPERTENSION

One or More Instructions to Return to Physician?

	Pct. No	Pct. Yes	Pct. All
Unconfirmed	38.9	61.1	100.0
Confirmed	3.7	96.3	100.0

Chi square $X^2=166.7$, 1 df, $p<.001$
Contingency coefficient c.c=.40; gamma = .89

One or More Instructions to Return for Lab or X-ray Test

	Pct. No	Pct. Yes	Pct. All
Unconfirmed	69.5	30.5	100.0
Confirmed	23.0	77.0	100.0

Chi square $X^2=189.7$, 1 df, $p<.001$
Contingency coefficient c.c=.42; gamma = .77

One or More Instructions to Return for Tests, Physician Visit, Hospitalization, or Any Other Care

	Pct. No	Pct. Yes	Pct. All
Unconfirmed	29.8	70.2	100.0
Confirmed	1.5	98.5	100.0

Chi square $X^2=136.7$, 1 df, $p<.001$
Contingency coefficient c.c=.37; gamma = .93

TABLE 7-7

FREQUENCY OF COMORBIDITIES AMONG 465 HYPERTENSIVE EPISODES

Comorbidity	N of Episodes with Comorbidity	Pct. with Comorbidity
Obesity	237	51.0
Oral contraceptive use	9	1.9
Pregnancy	1	0.2
Diabetes	74	15.9
Gout	26	5.6
Cerebrovascular disease	37	8.0
Heart disease	102	21.9
Renal disease	26	5.6
Vascular disease	33	7.1
Adverse drug reaction	41	8.8

These do not sum to 100%, since some patients have more than one comorbidity.

TABLE 7-8

DIAGNOSIS STATUS OF HYPERTENSION EPISODES

Diagnosis Status at Index Contact	N	Pct.
Tentative	56	12.0
Established	409	88.0
	465	100.0

Number of Contacts in entire episode with Diagnosis Coded as "Unknown" or "Tentative"	N	Pct.
0	379	81.5
1	60	12.9
2	16	3.5
3 or more	10	2.1
	465	100.0

TABLE 7-9

HYPERTENSION: PRESENTING OR ASSOCIATED MORBIDITY

Morbidity Status at Index Contact	N	Pct.
Presenting	110	23.7
1st Associated	188	40.4
2nd Associated	102	21.9
3rd-6th Associated	65	14.0
	465	100.0

Percent of Contacts in Episode with Hypertension as Presenting Morbidity	N	Pct.
0	25	5.4
1-25	63	13.5
26-50	143	30.8
51-75	168	36.1
76-99	59	12.7
100	7	1.5
	465	100.0

Mean percent of contacts in episodes with hypertension as presenting morbidity:	50.5%
Median percent	52.9%

TABLE 7-10

NUMBER OF COMORBIDITIES WITH HYPERTENSION

Number of Comorbidities at Index Contact	N	Pct.
0	51	11.0
1	114	24.5
2	114	24.5
3	86	18.6
4	54	11.6
5 or more	46	9.8
	465	100.0

Mean 2.3
S.E. 0.08
Median 2.1
Range 0-8

Mean No. Comorbidities Present per Contact in Episode	N	Pct.
0	1	0.2
0.1-1.00	120	25.8
1.01-1.50	135	29.0
1.51-2.00	115	24.7
2.01-2.50	43	9.3
2.51 or more	51	11.0
	465	100.0

Mean 1.6
S.E. 0.04
Median 1.4
Range 0-4.5

TABLE 7-11

YEAR OF INDEX CONTACT FOR HYPERTENSION EPISODES

Year	N	Pct.
1966	59	12.7
1967	113	24.3
1968	60	12.9
1969	56	12.0
1970	69	14.8
1971	43	9.2
1972	55	11.8
1973	10	2.3
	465	100.0

TABLE 7-12

HYPERTENSION EPISODE DURATION, FIRST TO LAST PATIENT CONTACT WITH HEALTH PLAN

Duration	N	Pct.
6.0-11.99 mos.	45	9.7
1.0- 1.99 yrs.	84	18.1
2.0- 2.99 yrs.	65	14.0
3.0- 3.99 yrs.	72	15.5
4.0- 4.99 yrs.	52	11.2
5.0- 5.99 yrs.	57	12.3
6.0- 6.99 yrs.	82	17.6
7.0 or more	8	1.6
	465	100.0

Mean dur. - 3.7 years
Std. error - 0.1 years
Median dur.- 3.5 years
Range - 6 months-7.15 years

TABLE 7-13

PHYSICIAN AND NONPHYSICIAN PROVIDERS OF CARE IN EPISODES OF HYPERTENSION

No. of Contacts in Episode with Nonphysician Provider	N	Pct.
0	438	94.2
1	18	3.9
2-3	6	1.3
4 or more	3	0.6
	465	100.0

Mean 0.14
S.E. 0.06
Range 0-27

TABLE 7-14

SPECIALTY OF PHYSICIANS TREATING HYPERTENSION

Physician Specialty at Index Contact	N	Pct.
Internist	443	95.3
Ob-Gyn	7	1.6
Ophthalmologist	2	0.4
Orthopedist	3	0.6
Surgeon	4	0.9
Urologist	2	0.4
Ear, nose, throat	1	0.2
(NHP) Physician assistant, nurse practitioner	2	0.4
Emergency surgery	1	0.2
	465	100.0

Physician Specialty Over Entire Episode	N	Pct.
Internists only	370	79.6
Internist and other spec.	94	20.2
Other specialties only	1	0.2
	465	100.0

TABLE 7-14 CONTINUED

SPECIALTY OF PHYSICIANS TREATING HYPERTENSION

Contacts with Internist	N	Pct.
0	1	0.2
1-5	104	22.3
6-10	155	33.3
11-15	82	17.6
16-20	47	10.1
21-30	50	10.8
31-40	14	3.0
More than 40	12	2.6
	465	100.0

Mean 12.7
S.E. 0.5
Median 9.6
Range 0-74

Contacts with Non-Internist	N	Pct.
0	370	79.6
1	51	11.0
2	21	4.5
3	15	3.2
4 or more	8	1.3
	465	100.0

No. of Episodes with 1 or more contacts with Provider Specialty:

Ob-Gyn	21	Urology	14	Emergency surg.	5
Opthalmol.	5	ENT	9	Other	8
Orthopedist	10	Mental Hlth	1		
Surgeon	23	NHP	19		

TABLE 7-15

STATUS OF PHYSICIANS WHO TREAT HYPERTENSION

Physician Status at Index Contact	N	Pct.
Regular attending	411	88.4
Temporary attending	45	9.7
Consultant	9	1.9
	465	100.0

No. of Contacts with Consultant Physician in Episode	N	Pct.
0	432	92.9
1	29	6.2
2 or more	4	0.9
	465	100.0

TABLE 7-16

HEALTH PLAN ELIGIBLITY FOR HYPERTENSION EPISODES

No. of Months in Year of Index Contact during which the Patient was Eligible for Health Plan Coverage	N	Pct.
0	2	0.4
1-5	80	17.2
6-11	53	11.4
12	330	71.0
	465	100.0

Eligibility at Index Contact	N	Pct.
No	4	0.9
Yes	461	99.1
	465	100.0

No. of Contacts in Episode in which Patient is ineligible for Health Plan Coverage	N	Pct.
0	444	95.5
1	10	2.2
2 or more	11	2.3
	465	100.0

TABLE 7-17

TIME OF DAY OF HYPERTENSION EPISODES

Time of Index Contact	N	Pct.
Regular medical office hours: 9 am-5pm, Mon-Sat	459	98.7
Evenings, Sundays, holidays	6	1.3
	465	100.0

Pct. of Contacts within Episode during Regular Medical Office Hours	N	Pct.
Some not in regular hours	139	29.9
All in regular hours	326	70.1
	465	100.0

No. of Contacts in Episode Not in Regular Hours	N	Pct.
0	326	70.1
1	91	19.6
2	29	6.2
3	12	2.6
4 or more	7	1.5
	465	100.0

TABLE 7-18

TYPE OF APPOINTMENTS FOR HYPERTENSION EPISODES

Type of Appointment at Index Contact	N	Pct.
Regular scheduled	386	83.0
Walk-in	57	12.3
Hospital emergency room	6	1.3
Phone, letter	12	2.6
Other (Inpatient)	4	0.9
	465	100.0

No. Walk-in Contacts in Episode	N	Pct.
0	239	51.4
1	121	26.0
2	57	12.3
3-5	41	8.8
6 or more	7	1.5
	465	100.0

TABLE 7-19

NUMBER OF CONTACTS PER HYPERTENSION EPISODE

No. of Contacts	N	Pct.
3	33	7.1
4	33	7.1
5	31	6.7
6	43	9.2
7	39	8.4
8	26	5.6
9	18	3.9
10	27	5.8
11-15	81	17.4
16-20	58	12.5
21-30	48	10.3
31-40	16	3.4
41-50	7	1.5
51-60	2	0.4
More than 60	3	0.6
	465	100.0

Mean 13.1
S.E. 0.5
Median 9.6
Range 3-77

TABLE 7-20

PLACE OF SERVICE FOR HYPERTENSION EPISODES

Place of Service, Index Contact	N	Pct.
Medical office	443	95.3
Hospital emergency room	6	1.3
Telephone or letter	12	2.6
Hospital inpatient	4	0.9
	465	100.0

Number of Contacts in Episode, by Place of of Service	Hospital		Medical Office		Emergency Room		Phone/ Letter		Any Other*	
	N	Pct.	N	Pct.	N	Pct.	N	Pct.	N	Pct.
0	411	88.4	0	0.0	423	91.0	192	41.3	441	94.8
1	34	7.3	0	0.0	34	7.3	104	22.4	20	4.3
2	14	3.0	0	0.0	6	1.3	62	13.3	0	0.0
3-5	4	0.8	147	31.6	2	0.4	74	15.9	2	0.4
6-10	2	0.4	139	29.9	--	--	27	5.8	1	0.2
11-15	--	--	74	15.9	--	--	5	1.1	0	0.0
16-20	--	--	44	9.4	--	--	0	0.0	0	0.0
21-30	--	--	46	9.9	--	--	1	0.2	1	0.2
More than 30	--	--	15	3.2	--	--	--	--	--	--
Mean	0.2		11.0		0.1		1.7		0.1	
S.E.	0.03		0.4		0.02		0.1		0.07	
Median	0.07		7.9		0.05		0.9		0.03	
Range	0-6		3-60		0-3		0-21		0-29	
Percent of total contacts, all episodes	1.2		86.1		0.9		11.2		0.5	

*Denotes system contact at patient's house, laboratory or x-ray contact without a physician contact, etc.

TABLE 7-21

DRUG-RELATED TELEPHONE CALLS FOR HYPERTENSION EPISODES

Percent Drug Telephone Calls of Total Telephone Calls in Episode	N*
0	36
33-90	56
100	144
	236

Mean pct. calls drug-related: 75.7
S.E.: 2.4
Median: 99.6
Range: 0-100

*N is episodes which included at least one telephone call.

No. of Drug-Related Telephone Calls in Episode	N	Pct.
0	265	57.0
1	84	18.1
2	56	12.0
3	22	4.7
More than 3	38	8.2
	465	100.0

Mean 1.0
S.E. 0.08
Median 0.4
Range 0-10

TABLE 7-22

MEDICAL OFFICE CONTACTS PER EPISODE OF HYPERTENSION

Number of Contacts in Episode	Medical Office		Followup Office Visit		Physical Examination Comorbidity	
	N	Pct.	N	Pct.	N	Pct.
0	0	0.0	47	10.0	45	9.7
1	0	0.0	67	14.4	106	22.8
2	0	0.0	54	11.6	107	23.0
3-5	147	31.6	134	28.8	149	32.0
6-10	139	29.9	103	22.2	57	12.3
11-15	74	15.9	29	6.2	1	0.2
16-20	44	9.4	21	4.5	--	--
21-30	46	9.9	8	1.7	--	--
31+	15	3.2	2	0.4	--	--
Mean	11.0		5.4		2.8	
S.E.	0.4		0.3		0.1	
Median	7.9		3.6		2.3	
Range	3-60		0-42		0-11	

TABLE 7-23

PROPORTION OF CONTACTS IN HYPERTENSION EPISODES THAT WERE PHYSICAL EXAMINATIONS

Percent of Contacts with Physical Examination as Comorbidity	N	Pct.
0	45	9.7
1-25	220	47.3
26-50	160	34.4
51-99	38	8.2
100	2	0.4
	465	100.0

Mean Pct. with P.E. -	26.3%
S.E.	0.9%
Median	23.5%
Range	0-100%

TABLE 7-24

PHYSICAL EXAMINATIONS PER EPISODE YEAR FOR HYPERTENSION

No. of Exams	N	Pct.
0	45	9.7
.01-.49	94	20.2
.50-.99	160	34.4
1-1.49	108	23.2
1.5-1.99	41	8.8
2 or more	17	3.7
	465	100.0

Mean phys. exam/yr:	0.9
Median	0.8
S.E.	0.03
Range	0-3.8

TABLE 7-25

MEDICAL OFFICE CONTACTS PER YEAR FOR HYPERTENSION EPISODES

Rate/Yr	Number of Episodes with Medical Office Contacts (Hypertension Either Presenting or Associated Morbidity.)	Pct.	Number of Episodes with Followup Office Visits with Hypertension as Presenting Morbidity	Pct.
0	0	0.0	47	10.1
.01-.49	2	0.4	65	14.0
.50-.99	24	5.2	79	17.1
1.00-1.49	52	11.2	76	16.3
1.50-1.99	50	10.8	57	12.3
2.00-2.99	115	24.7	63	13.5
3.00-3.99	74	15.9	34	7.3
4.00-4.99	54	11.6	13	2.8
5.00-5.99	39	8.4	15	3.2
6.00-6.99	20	4.3	3	0.6
7.00-7.99	7	1.5	6	1.3
8.00 or more	28	6.0	7	1.5
	465	100.0	465	100.0

Mean	3.5	1.8
S.E.	0.1	0.1
Median	2.9	1.3
Range	.4-20.7	0-19.7

TABLE 7-26

NUMBER OF LABORATORY AND RADIOLOGY PROCEDURES PER HYPERTENSION EPISODE

No. of Tests	Laboratory		Radiology	
	N	Pct.	N	Pct.
0	124	26.7	338	72.7
1	55	11.8	107	23.0
2	43	9.2	18	3.9
3	49	10.5	--	--
4	32	6.9	1	0.2
5	28	6.0	1	0.2
6-10	84	18.1	--	--
11-20	40	8.6	--	--
More than 21	10	2.1	--	--
	465	100.0	465	100.0

	Laboratory	Radiology
Mean	4.3	0.3
S.E.	0.2	0.03
Range	0-34	0-5
Median	2.7	0.0

TABLE 7-27

SPECIFIC RADIOLOGY PROCEDURES FOR HYPERTENSION EPISODES

Procedure Name	Percent of Episodes With Number of Tests 0	1	2	3+	Mean Number Per Episode	Range	Cost Per Test*
Chest X-ray, 1 view	84.3	14.6	0.9	0.2	0.17	0-4	$6
Chest X-ray, 2 views	98.9	0.9	0.2	--	0.01	0-2	$9
All chest X-rays	83.4	15.1	1.3	0.2	0.19	0-4	Composite
Intravenous urography	89.0	10.8	0.2	--	0.11	0-2	$21
IV urography with hypertensive dye	97.8	2.2	--	--	0.02	0-1	$30
All IV urographies	86.9	12.9	0.2	--	0.13	0-2	Composite

*Cost-based on $3 per 1964 RVS unit; 1964 RVS Scale adapted by HSRC Staff

TABLE 7-28

COMBINATIONS OF RADIOLOGY PROCEDURES GIVEN IN HYPERTENSION EPISODES

Tests	N	Pct.
No chest X-ray or IVU	340	73.1
Chest X-ray only	64	13.8
IVU only	48	10.3
Chest X-ray and IVU	13	2.8
	465	100.0

TABLE 7-29

SPECIFIC LABORATORY TESTS IN HYPERTENSION EPISODES

Test Name	Percent of Episodes with Given Number of Tests								Mean Number Per Episode	Range	Cost Per Test
	0	1	2	3	4	5	6-10	11+			
Blood urea nitrogen; blood creatinine	71.6	17.0	8.4	1.5	1.1	0.2	0.2	--	0.45	0-7	$3
Creatinine clearance	98.5	0.9	0.6	--	--	--	--	--	0.02	0-2	$4.50
All creatinine	71.2	16.8	8.2	2.2	1.3	0.2	0.2	--	0.47	0-7	Composite
Phosphorus	95.1	4.5	0.4	--	--	--	--	--	0.05	0-2	$3
Potassium	43.7	29.7	12.5	5.8	2.8	1.3	3.4	0.8	1.26	0-17	$3
Sodium	66.9	21.3	6.9	2.6	1.1	0.6	0.6	--	0.55	0-10	$3
All electrolyte	43.4	13.8	19.0	7.7	5.3	3.0	5.1	2.6	1.87	0-20	$3
Glucose cola	88.0	9.7	2.4	--	--	--	--	--	0.14	0-2	$3
Uric acid	89.9	8.8	0.9	--	0.2	--	0.2	--	0.13	0-8	$3
VMA, catecholamines	93.8	5.8	0.4	--	--	--	--	--	0.07	0-2	$9
Urinalysis	84.5	14.4	0.9	--	0.2	--	--	--	0.17	0-4	$1.50
Electrocardiogram	75.1	20.6	3.9	0.2	0.2	--	--	--	0.30	0-4	$9
T_3	99.1	0.9	--	--	--	--	--	--	0.01	0-1	$6
T_4	98.3	1.7	--	--	--	--	--	--	0.02	0-1	$6
PBI	98.9	1.1	--	--	--	--	--	--	0.01	0-1	$3
All thyroid tests	97.2	1.9	0.9	--	--	--	--	--	0.04	0-2	Composite
Complete blood count	91.4	7.1	1.5	--	--	--	--	--	0.10	0-2	$3.60

TABLE 7-30

COMBINATIONS OF LABORATORY TESTS GIVEN IN HYPERTENSION EPISODES

Tests	N	Pct.
No laboratory tests given	124	26.7
1+ EKG, only	19	4.1
1+ creatinine, only	1	0.2
1+ electrolyte, only	49	10.5
1+, any other laboratory test, only	32	6.9
1+ EKG, 1+ electrolyte	7	1.5
1+ EKG, 1+ other	14	3.0
1+ electrolyte, 1+ creatinine	20	4.3
1+ creatinine, 1+ other	8	1.7
1+ electrolyte, 1+ other	63	13.5
1+ EKG, 1+ creatinine, 1+ electrolyte	4	0.9
1+ EKG, 1+ creatinine, 1+ other	4	0.9
1+ EKG, 1+ electrolyte, 1+ other	23	4.9
1+ creatinine, 1+ electrolyte, 1+ other	52	11.2
1+ EKG, 1+ creatinine, 1+ electrolyte, 1+ other	45	9.7
	465	100.0

TABLE 7-31

LABORATORY TESTS PER YEAR FOR HYPERTENSION EPISODES

Rate of Tests/Year	N	Pct.
0	124	26.7
.01-.49	69	14.8
.50-.99	79	17.0
1 - 1.99	78	16.8
2 - 2.99	42	9.0
3 - 4.99	37	8.0
5 or more	36	7.7
	465	100.0

Mean	1.6
S.E.	0.1
Median	0.7
Range	0-17.7

TABLE 7-32

DRUG THERAPY, FOR HYPERTENSION EPISODES BEGINNING IN 1972 AND 1973

Number of Prescriptions	All Drugs		Diuretics		Other Anti-Hypertensives		All Other Drugs		Electrolyte		Tranquilizer	
	N	Pct.	N	Pct.	N	Pct.	N	Pct.	N	Pct.	N	Pct.
0	8	12.3	18	27.7	42	64.6	45	69.2	64	98.5	60	92.3
1	5	7.7	4	6.2	4	6.2	10	15.4	--	--	5	7.7
2	10	15.4	11	16.9	4	6.2	5	7.7	1	1.5	--	--
3	7	10.8	12	18.5	5	7.7	4	6.2	--	--	--	--
4	11	16.9	8	12.3	2	3.1	--	--	--	--	--	--
5	5	7.7	5	7.7	3	4.6	1	1.5	--	--	--	--
6-10	12	18.5	7	10.7	3	4.6	--	--	--	--	--	--
11-15	5	7.7	--	--	2	3.0	--	--	--	--	--	--
16-25	2	3.0	--	--	--	--	--	--	--	--	--	--
	65	100.0	65	100.0	65	100.0	65	100.0	65	100.0	65	100.0
Mean	4.74		2.55		1.59		0.60		0.03		0.08	
S.E.	0.6		0.3		0.4		0.1		0.03		0.03	
Range	0-25		0-8		0-14		0-7		0-2		0-1	
Median	3.7		2.5		0.3		0.2		0.01		0.04	

TABLE 7-33

COMBINATIONS OF DRUGS ORDERS FOR HYPERTENSION

Drug	N	Pct.
None	8	12.3
Diuretic only	26	40.0
Other antihypertensive, only	7	10.8
Other miscellaneous drugs, only	2	3.1
Diuretic, other antihypertensive	4	6.2
Other antihypertensives, and miscellaneous drugs	1	1.5
Diuretic, and miscellaneous drugs	6	9.2
Diuretic, other antihypertensive and miscellaneous drugs	11	16.9
	65	100.0

TABLE 7-34

COSTS OF CARE FOR HYPERTENSION EPISODES

Dollars	Total Dollars N	Total Dollars Pct.	Laboratory N	Laboratory Pct.	X-Ray N	X-Ray Pct.	Office Visit N	Office Visit Pct.	Phone N	Phone Pct.	Letter N	Letter Pct.	Office Procedure N	Office Procedure Pct.
0	16	3.4	124	26.7	338	72.7	40	8.6	229	49.2	429	92.3	457	98.3
1-10	56	12.0	132	28.4	59	12.7	111	23.9	225	48.4	34	7.3	6	1.3
11-20	70	15.0	77	16.6	7	1.5	110	23.7	11	2.4	1	0.2	1	0.2
21-30	53	11.4	68	14.6	46	9.9	47	10.1	--	--	1	0.2	--	--
31-40	46	9.9	22	4.7	12	2.6	44	9.5	--	--	--	--	--	--
41-50	45	9.7	21	4.5	2	0.4	45	9.7	--	--	--	--	--	--
51-60	40	8.6	8	1.7	0	0	20	4.3	--	--	--	--	1	0.2
61-70	21	4.5	3	0.6	1	0.2	6	1.3	--	--	--	--	--	--
71-80	25	5.4	4	0.9	--	--	10	2.1	--	--	--	--	--	--
81-90	19	4.1	3	0.6	--	--	7	1.5	--	--	--	--	--	--
91-100	19	4.1	0	0	--	--	13	2.8	--	--	--	--	--	--
101-200	48	10.3	3	0.6	--	--	11	2.4	--	--	--	--	--	--
More than 200	7	1.5	--	--	--	--	1	0.2	--	--	--	--	--	--
	465	100.0	465	100.0	465	100.0	465	100.0	465	100.0	465	100.0	465	100.0
Mean	$50.77		$14.99		$4.28		$29.10		$1.95		$0.25		$0.20	
S.E.	$2.18		$0.86		$0.41		$1.36		$0.14		$0.06		$0.13	
Range	$0-$321.70		$0-$125.70		$0-$66		$0-$220		$0-19.50		$0-21		$0-60	
Median	$38.50		$9.00		$0.56		$19.85		$0.80		$0.02		$0.02	
Pct. Total Costs	100		29.5		8.4		57.3		3.8		0.5		0.4	

TABLE 7-35

COST PER EPISODE YEAR FOR HYPERTENSION EPISODES

Dollars/Year	N	Pct.
0	16	3.4
$0.52 - $2.50	33	7.1
$2.51 - $5.00	57	12.2
$5.01 - $7.50	48	10.3
$7.51 - $10.00	46	9.9
$10.01 - $12.50	38	8.2
$12.51 - $15.00	35	7.5
$15.01 - $17.50	33	7.1
$17.51 - $20.00	27	5.8
$20.01 - $25.00	34	7.3
$25.01 - $30.00	25	5.4
$30.01 - $40.00	28	6.0
$40.01 - $60.00	20	4.3
More than $60	25	5.4
	465	100.0

Mean	$18.45/year
S.E.	$0.99
Median	$12.28/year
Range	$0-$153.68/year

TABLE 7-36

TYPES OF CONTACTS, FIRST SIX MONTHS OF HYPERTENSION EPISODE

	Hospital Admissions		Medical Office Contacts		Emergency Room Contacts		Phone, Letter		Drug Phone Calls	
No. in Episode	N	Pct.	N	Pct.	N	Pct.	N	Pct.	N	Pct.
0	449	96.6	7	1.5	452	97.2	382	82.2	425	91.4
1	12	2.6	115	24.7	13	2.8	54	11.6	28	6.0
2	4	0.9	119	25.6	--	--	19	4.1	10	2.2
3	--	--	99	21.3	--	--	7	1.5	2	0.4
4	--	--	55	11.8	--	--	2	0.4	--	--
5	--	--	33	7.1	--	--	1	0.2	--	--
6	--	--	15	3.2	--	--	--	--	--	--
7	--	--	13	2.8	--	--	--	--	--	--
8 or more	--	--	9	1.1	--	--	--	--	--	--
	465	100.0	465	100.0	465	100.0	465	100.0	465	100.0
Mean	0.4		2.8		0.03		0.3		0.1	
S.E.	0.01		0.08		0.01		0.03		0.02	
Median	0.02		2.4		0.01		0.1		0.05	
Range	0-2		0-13		0-1		0-5		0-3	
Pct. of total episode mean	22.7		25.4		23.2		15.9		11.1	

$$\frac{\text{Duration of workup period}}{\text{Mean duration, all 465 episodes}} = \frac{\text{180 days}}{\text{1342 days}} = 13.4\%$$

TABLE 7-37

MEDICAL OFFICE CONTACTS FOR HYPERTENSION, FIRST SIX MONTHS OF EPISODE

Number of Contacts	All Medical Office Contacts		Followup Office Visit, Hypertension as Presenting Morbidity		Physical Examination	
	N	Pct.	N	Pct.	N	Pct.
0	7	1.5	185	39.8	460	98.9
1	115	24.7	121	26.0	5	1.1
2	119	25.6	88	18.9	--	--
3	99	21.3	30	6.5	--	--
4	55	11.8	20	4.3	--	--
5	33	7.1	9	1.9	--	--
6	15	3.2	9	1.9	--	--
7	15	2.8	2	0.4	--	--
8 or more	9	1.1	1	0.2	--	--
	465	100.0	465	100.0	465	100.0
Mean	2.8		1.3		0.01	
S.E.	0.08		0.07		0.005	
Median	2.4		0.9		0.005	
Range	0-13		0-13		0-1	
Mean in First Six months as Percent of Episode Mean	25.4		23.5		32.3	

TABLE 7-38

RADIOLOGY AND LABORATORY SERVICES FOR HYPERTENSION, FIRST SIX MONTHS

Test	Pct. Episodes with:				Mean	Range	Mean in First Six Months as Pct. of Episode Mean
	0	1	2	3+			
Chest x-ray	93.3	6.5	0.2	--	0.07	0-2	37.2
IV urography	92.7	7.3	--	--	0.07	0-1	54.9
Glucose	94.8	4.7	0.4	--	0.06	0-2	38.9
Uric acid	97.4	2.2	0.2	0.2	0.03	0-4	25.9
VMA/catecholamine	95.7	4.1	0.2	--	0.05	0-2	67.6
Urinalysis	92.0	7.3	0.6	--	0.09	0-2	50.6
EKG	88.8	11.0	0.2	--	0.11	0-2	38.1
Complete blood count	97.4	2.6	--	--	0.03	0-1	25.7
Creatinine	88.2	9.7	2.2	--	0.14	0-2	29.5
Electrolyte	77.8	9.5	9.0	3.6	0.41	0-6	22.2
Thyroid	99.4	0.4	0.2	--	0.01	0-2	24.3

TABLE 7-39

DRUG ORDERS FOR HYPERTENSION, FIRST SIX MONTHS, EPISODES BEGINNING IN 1972 AND 1973

Number of Drug Orders	Any Drug		Diuretic		Other Anti-Hypertensive	
	N	Pct.	N	Pct.	N	Pct.
0	17	26.1	24	36.9	47	72.3
1	9	13.8	9	13.8	6	9.3
2	10	15.4	14	21.6	3	4.6
3	12	18.5	13	20.0	2	3.1
4	7	10.8	4	6.2	4	6.2
5 or more	10	15.4	1	1.5	3	4.6
	65	100.0	65	100.0	65	100.0
Mean	2.6		1.5		0.8	
S.E.	0.3		0.2		0.2	
Median	2.2		1.4		0.2	
Range	0-11		0-5		0-8	
Mean, first six months, as pct. of episode mean		54.9		58.8		50.5

$$\frac{\text{Duration of workup per episode}}{\text{Average duration per episode starting 1972 \& 1973}} = \frac{\text{180 days}}{\text{410 days}} = .439 \times 100 = 43.9\%$$

TABLE 7-40

COST FOR HYPERTENSION EPISODES, FIRST SIX MONTHS

	Total Cost		Lab costs		Radiology Costs		Medical Costs	
Dollars	N	Pct.	N	Pct.	N	Pct.	N	Pct.
0	132	28.4	304	65.4	406	87.3	155	33.3
1-5	80	17.2	33	7.1	0	0.0	109	23.4
6-10	63	13.5	53	11.4	23	4.9	81	17.4
11-20	79	17.0	44	9.4	2	0.4	82	17.6
21-30	41	8.8	21	4.5	34	7.3	28	6.0
31-40	23	4.9	2	0.4	--	--	8	1.7
41-50	19	4.1	7	1.5	--	--	1	0.2
More than 50	28	6.0	1	0.2	--	--	1	0.2
	465	100.0	465	100.0	465	100.0	465	100.0
Mean	$14.60		$4.50		$2.10		$7.90	
S.E.	0.90		0.40		0.30		0.40	
Median	$ 8.00		$0.00		$0.20		$5.00	
Range	$0-93.20		$0-52.50		$0-30		$0-75	
Percent of First Six Months' Cost	100.0		31.2		14.4		54.4	
Mean Costs in First Six Months, as Percent of Episode Mean	28.7		30.3		49.0		25.2	

TABLE 7-41

MEAN COSTS PER YEAR FOR HYPERTENSION EPISODES, BY THE PRESENCE OR ABSENCE OF ADVERSE DRUG REACTIONS

	N	Mean dollars/yr.	Mean office contacts/yr.
Adverse effects of drugs present	41	$25.20	4.9
No adverse effects of drugs	429	$17.80	3.4
F =		4.5	12.8
p =		.03	.0004
ETA^2 =		.01	.03

TABLE 7-42

MEAN COSTS PER YEAR FOR HYPERTENSION EPISODES, BY NEW VS. CONTINUING EPISODES

	Mean Dollars/Yr	S.E.	N	F=	p=	ETA^2=
New	20.9	1.4	313	12.9	.0004	.03
Continuing	13.4	1.1	152			

TABLE 7-43

MEAN COSTS PER YEAR FOR HYPERTENSION EPISODES, BY PRESENCE OF ANY NON-PHYSICIAN PROVIDER CONTACTS IN THE EPISODE

	Mean Dollars/Yr	S.E.	N	F=	p=	ETA^2=
No nonphysician contact	17.9	1.0	437	5.2	.02	.01
1+ nonphysician contact	27.3	5.0	28			

TABLE 7-44

MEAN COSTS PER YEAR FOR HYPERTENSION EPISODES, BY PRESENCE OF INELIGIBLE CONTACTS IN THE EPISODE

	Mean Dollars/Yr	S.E.	N	F=	p=	ETA^2=
No ineligible contacts in episode	17.4	.95	444	24.7	.0001	.05
Ineligible contacts in episode	40.6	7.6	21			

TABLE 7-45

MEAN COSTS PER YEAR FOR HYPERTENSION EPISODES, BY PRESENCE OR ABSENCE OF RADIOLOGY PROCEDURE IN EPISODE

	Mean Dollars/Yr	S.E.	N	F=	p=	ETA^2=
No x-ray	$13.50	.84	338	78.3	.0001	.14
1+ x-rays	$31.70	2.5	127			

TABLE 7-46

MEAN COSTS PER YEAR FOR HYPERTENSION EPISODES, BY PRESENCE OR ABSENCE OF ANY DRUG ORDER IN EPISODE

	Mean Dollars/Yr	S.E.	N*	F=	p=	ETA^2=
No drugs ordered	12.30	6.7	8	10.1	.0023	.14
1+ drugs ordered	47.30	4.0	57			

*Population for drug data is only those episodes which began in 1972 or 1973.

TABLE 7-47

MEAN COSTS PER YEAR FOR HYPERTENSION EPISODES, BY PRESENCE OR ABSENCE OF INDEX CONTACT INSTRUCTIONS TO RETURN FOR CARE

	Mean Dollars/Yr	S.E.	N	F=	p=	ETA^2=
No return ordered	12.8	.90	181	21.1	.0001	.04
1+ returns ordered	22.1	1.50	284			

TABLE 7-48

MEAN WORKUP PERIOD COSTS FOR HYPERTENSION, BY PRESENCE OR ABSENCE OF SYMPTOMS AT INDEX CONTACT

	N	Mean Dollar Cost	S.E.	F=	p=	ETA^2=
No symptoms	449	$14.20	.90	4.2	.04	.01
Symptoms	16	$24.00	6.0			

TABLE 7-49

MEAN WORKUP PERIOD COSTS FOR HYPERTENSION, BY NEW OR CONTINUING EPISODE

	N	Mean Dollar Cost	S.E.	F=	p=	ETA^2=
Continuing	152	$ 9.40	$0.80	17.7	.0001	.04
New	313	$17.80	$1.20			

TABLE 7-50

MEAN WORKUP PERIOD COSTS FOR HYPERTENSION, BY ELIGIBILITY AT THE INDEX CONTACT

	N	Mean Dollar Cost	S.E.	F=	p=	ETA^2=
Eligible	461	$14.40	.90	6.9	.0086	.01
Ineligible	4	$39.00	6.10			

TABLE 7-51

MEAN WORKUP PERIOD COSTS FOR HYPERTENSION, BY PRESENCE OF INSTRUCTIONS TO RETURN FOR FURTHER CARE AFTER INDEX CONTACT

	N	Mean Dollar Cost	S.E.	F=	p=	ETA^2=
No ret. requested	181	$ 7.00	.80	53.7	.0001	.10
Return requested	284	$19.40	1.25			

TABLE 7-52

VARIABLES IN AID ANALYSIS OF SUBCOMPONENTS OF TOTAL UTILIZATION OF CARE FOR ALL 465 EPISODES.

1. Hospitalization (0, 1, 2 or more)
2. Emergency room contacts (0, 1 or more)
3. Telephone or letter contacts (0, 1, 2, 3, 4, 5 or more)
4. Drug-related telephone calls (0, 1, 2, 3, 4 or more)
5. Glucose tests (0, 1-2)
6. Uric acid tests (0, 1 or more)
7. VMA-catecholamine tests (0, 1-2)
8. Urinalyses (0, 1 or more)
9. EKGs (0, 1, 2 or more)
10. Chest x-rays (0, 1 or more)
11. Intravenous urographies (0, 1-2)
12. Complete blood counts (0, 1-2)
13. Creatinine/BUN tests (0, 1, 2, 3 or more)
14. Physical exams with hypertension as the presenting morbidity (0, 1-2)
15. Initial office visits for hypertension (0, 1)
16. House, nursing home, other miscellaneous contact types (0, 1 or more)
17. Followup office visits per year for hypertension (0, .01-.49, .50-.99, 1.00-1.49, 1.50-1.99, 2.00-2.99, 3.00-3.99, 4.00-4.99, 5.00-5.99, 6-20)
18. Electrolyte tests (0, 1, 2, 3, 4, 5 or more)
19. Phosphorus tests (0, 1-2)
20. Potassium tests (0, 1, 2, 3, 4, 5 or more)
21. Sodium tests (0, 1, 2, 3 or more)
22. Physical exams per year; hypertension as presenting or associated morbidity (0, .01-.49, .50-.99, 1.00-1.49, 1.50 or more)
23. Dollar cost per episode year

TABLE 7-53

COMPOSITION OF BUNDLES OF CARE FOR ALL HYPERTENSION EPISODES

			Mean Number Given During Entire Episode[1]							
	Bundle N		Drug Orders		Laboratory Tests[2]		Chest X-rays and Intravenous Urography		Follow-up Office Visits/Year	
Bundle	All	'72-'73	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean[3]	S.D.
1. 0-.99 followup OV/yr.	178	10	0.7	1.06	1.67	2.30	.10	.30	1.15	.80
2. 1-1.99 followup OV/yr.	83	4	2.25	1.50	1.55	1.90	.17	.38	3.42	.50
3. 1-1.99 followup OV/yr. sodium test	31	5	1.40	0.55	6.03	3.41	.19	.40	3.39	.49
4. 2-2.99 followup OV/yr.	51	6	1.83	0.75	4.00	3.89	.25	.44	5.00	0
5. 1+ intravenous urography; 0-1.99 followup Ov/yr.	32	2	1.50	0.71	3.97	2.29	1.19	.40	2.69	1.20
6. 3-3.99 followup OV/yr.	29	7	2.28	0.76	4.03	3.79	.21	.41	6.00	0
7. 2-3.99 followup OV/yr. with intravenous urography	17	8	1.62	1.06	5.82	3.26	1.24	.44	5.29	.47
8. 4-5.99 followup OV/yr.	28	13	2.38	0.78	4.82	4.63	.46	.58	7.53	.51
9. 6+ followup OV/yr.	16	10	2.60	0.70	4.06	4.17	.56	.73	9.00	0
F =			4.1		16.4		40.5		668	
p =			.0006		<.0001		<.0001		<.0001	
ETA^2 =			.37		.22		.41		.92	

[1] All episodes are counted for laboratory tests, radiology procedures, and followup office visits. For drug orders, only episodes beginning in 1972 and 1973 are counted.

[2] Sum of the number of these tests in the episode: phosphorus, potassium, sodium, glucose, uric acid, catecholamines/VMA, urinalysis, EKG, complete blood count, and BUN/creatinine.

[3] Based on a recoding of followup office visits per episode year, in which:
1 = .01-.49 office visits/year; 2 = .50-.99 OVs/year; 3 = 1.00-1.49 OVs/year; 4 = 1.50-1.99 OVs/year; 5 = 2.00-2.99 OVs/year; 6 = 3.00-3.99 OVs/year; 7 = 4.00-4.99 OVs/year; 8 = 5.00-5.99 OVs/year; 9 = 6 or more OVs/year.

TABLE 7-54

VARIABLES INCLUDED IN PATIENT/PROVIDER/MEDICAL CARE PROCESS AID ANALYSIS, FOR ALL HYPERTENSION EPISODES

1. Consultant physician seen in episode? (y/n)

2. Is obesity a comorbidity at any contact? (y/n)

3. Is heart disease a comorbidity at any contact? (y/n)

4. Are drug adverse effects a comorbidity in any episode? (y/n)

5. Does patient have comorbidities related to hypertension? (y/n)

6. Comorbidity group (heart, vascular, or cerebrovascular disease; diabetes without above; obesity without above; renal disease, oral contraceptive use, pregnancy without above, none of above)

7. Are any contacts with a non-physician provider? (y/n)

8. Are any contacts with a non-internist physician? (y/n)

9. Are any contacts walk-in? (y/n)

10. Is the diagnosis tentative or unknown at any contact? (y/n)

11. Are any contacts outside of regular medical office hours? (y/n)

12. Percent of total contacts that are physical exams (0%, 1-25%, 26-50%, 50-100%)

13. Is the patient ineligible for Health Plan coverage at any contact? (y/n)

14. Year of index contact. (1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973)

15. Sex (male, female)

16. Age at index contact (18-34, 35-49, 50-64, 65-74, 75+)

17. New or continuing episode

18. Are symptoms present at index contact? (y/n)

19. Is the patient eligible for Health Plan coverage during the full calendar year that includes the index contact? (y/n)

20. Physician status at index contact (regular attending, temporary attending, consultant)

21. Subscriber unit size at index contact (1, 2, 3, 4, 5 or more)

22. Is a physical examination present within the episode? (y/n)

23. Dollar cost per episode year

TABLE 7-55

VARIABLES INCLUDED IN UTILIZATION AID ANALYSIS, FOR 313 'NEW' HYPERTENSION EPISODES; FOR THE FIRST SIX MONTHS OF THE EPISODE

1. Hospital admission (0, 1-2)
2. Phone or letter contacts (0, 1, 2 or more)
3. Drug-related phone calls (0, 1 or more)
4. Chest x-rays (0, 1-2)
5. Intravenous urography (0, 1)
6. Glucose tests (0, 1-2)
7. Catecholamine-VMA test (0, 1-2)
8. Urinalysis (0, 1-2)
9. EKG (0, 1-2)
10. Electrolytes (potassium, sodium, or phosphorus) (0, 1, 2, 3 or more)
11. Initial office visit (0, 1-2)
12. Followup office visit (0, 1, 2, 3, 4, 5 or more)
13. Creatinine-BUN tests (0, 1-2)
14. Total dollar costs, first six months

TABLE 7-56

COMPOSITION OF BUNDLES OF CARE FOR WORKUP OF NEW HYPERTENSION EPISODES

			Number Given During Workup Period[1]							
	Bundle N		Drug Orders		Laboratory Tests[2]		Chest X-rays and Intravenous Urography		Follow-up Office Visits	
Bundle	All	'72-'73	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
1. 0 followup OV, initial OV, IVU	119	13	0.38	.65	.26	.67	.01	.09	0	0
2. 1 followup OV; 0 initial OV	59	8	1.00	.75	.69	1.22	.03	.18	1	0
3. 2 followup OV, 0 electrolyte tests	26	5	1.60	.54	.34	.84	.08	.27	2	0
4. 1 initial OV, 0-1 followup OV	20	4	1.25	1.26	.75	1.25	.05	.22	0.55	0.51
5. 0 electrolyte tests, 3+ followup OVs	20	7	2.00	1.00	.40	.82	.10	.31	3.7	.73
6. 1+ electrolyte tests, 2 followup OVs	20	10	1.50	.85	3.45	1.46	.30	.47	2.0	0
7. 1+ electrolyte tests, 3+ followup OVs	16	4	2.25	.96	3.00	1.41	.12	.34	3.81	0.91
8. 1+ IVUs; 0-1 electrolyte tests	16	4	2.50	1.00	1.93	1.39	1.18	.40	2.56	1.63
9. 1+ IVUs; 2+ electrolyte tests	17	7	1.00	1.00	4.23	1.35	1.23	.44	2.47	1.66
F =			4.4		54.2		82.2		180	
p =			.0004		<.0001		<.0001		<.0001	
ETA^2 =			.40		.59		.68		.82	

---

[1] All episodes are counted for laboratory tests, radiology procedures, and followup office visits. For drug orders, only episodes beginning in 1972 and 1973 are counted.

[2] Sum of the number of these tests in the episode: phosphorus, potassium, sodium, glucose, catecholamines/VMA, urinalysis, EKG, and BUN/creatinine.

TABLE 7-57

VARIABLES INCLUDED IN PATIENT/PROVIDER/MEDICAL CARE PROCESS AID ANALYSIS, FOR FIRST SIX MONTHS OF 313 NEW HYPERTENSION EPISODES; ALL VARIABLES REFER TO CHARACTERISTICS PRESENT AT THE INDEX CONTACT

1. Year (1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973)
2. Sex (male, female)
3. Age (18-34, 35-49, 50-64, 65-74, 75 or more)
4. New or continuing episode (y/n)
5. Any symptoms present at index contact? (y/n)
6. Is the patient eligible for Health Plan coverage during the full calendar year that includese the index contact? (y/n)
7. Physician status at index contact (regular attending, temporary attending, consultant)
8. Subscriber unit size (1, 2, 3, 4, 5 or more)
9. Diagnosis status (tentative, established)
10. Physician specialty (internist, other)
11. Did the physician request patient to return for laboratory or radiology tests, or for an office visit? (y/n)
12. Place of service (medical office; elsewhere)
13. Type of appointment (reg. sched., walk-in, not a med. office visit)
14. Is a physical examination done at the index contact? (y/n)
15. Is obesity a comorbidity? (y/n)
16. Is heart disease a comorbidity? (y/n)
17. Is the patient free of comorbidities medically related to hypertension? (y/n)
18. Comorbidity group of the patient (heart, cerebrovascular, or vascular disease; diabetes w/o above; obesity w/o above; renal disease, oral contraceptive use, or pregnancy w/o above; none of the above)
19. Total dollar cost for the first six episode months

TABLE 7-58

HYPERTENSION BUNDLES OF CARE AS IDENTIFIED BY AID ANALYSIS AND USED IN LOG-LINEAR MODELING

All Cases, Utilization Over Entire Episode	N	Mean Dollars/Yr.	S.D.
1. < 1 followup OV/yr., 0 IVU	178	5.53	4.98
2. 1-1.99 followup OV/yr., 0 IVU	83	10.90	5.13
3. 1-1.99 followup OV/yr., 0 IVU, 1+ sodium	31	18.90	10.01
4. 2-2.99 followup OV/yr., 0 IVU	51	19.27	6.41
5. 0-1.99 followup OV/yr., 1+ IVU	32	22.06	9.13
6. 3-3.99 followup OV/yr., 0 IVU	29	28.65	10.71
7. 2-3.99 followup OV/yr., 1+ IVU	17	42.94	18.51
8. 4-5.99 followup OV/yr.	28	55.64	29.46
9. 6+ followup OV/yr.	16	80.50	32.31
	465		

New Episodes, Utilization Over First Six Months	N	Mean Total Dollars	S.D.
1. 0 IVU, 0 initial OV, 0 followup OV	119	1.68	4.08
2. 0 IVU, 0 initial OV, 1 followup OV	59	9.10	6.46
3. 0 IVU, 0 electrolyte tests, 2 followup OVs	26	15.53	8.46
4. 0 IVU, 1 initial OV, 0-1 followup OV	20	19.15	10.30
5. 0 IVU, 0 electrolyte tests, 3+ followup OVs	20	25.25	8.90
6. 0 IVU, 1+ electrolyte tests, 2 followup OVs	20	32.30	13.25
7. 0 IVU, 1+ electrolyte tests, 3+ followup OVs	16	43.87	17.49
8. 1+ IVU, 0-1 electrolyte tests	16	50.93	16.74
9. 1+ IVU, 2+ electrolyte tests	17	68.23	18.36
	313		

TABLE 7-59

LOG-LINEAR PARAMETERS DIVIDED BY THEIR STANDARD ERRORS (BETA VALUES) FOR ALL RELATIONSHIPS WITH P $\leq$ .05 - ALL 465 EPISODES

Bundle	Year 1966-68	1969-71	1972-73
1	2.803**(1.289)		-3.922***(0.679)
2-9	No significant relationships found for bundles 2-9.		

* - $p \leq 0.05$
** - $p \leq 0.01$
***- $p \leq 0.001$

Bundle	Questionable Diagnosis None	One or more	Age 18-49	50-74	75+
1	3.145***(1.231)	-3.145***(0.812)		3.602***(1.367)	-2.795**(0.76)
2				2.242* (1.238)	
3-9	No significant relationships found for bundles 3-9.				

TABLE 7-60

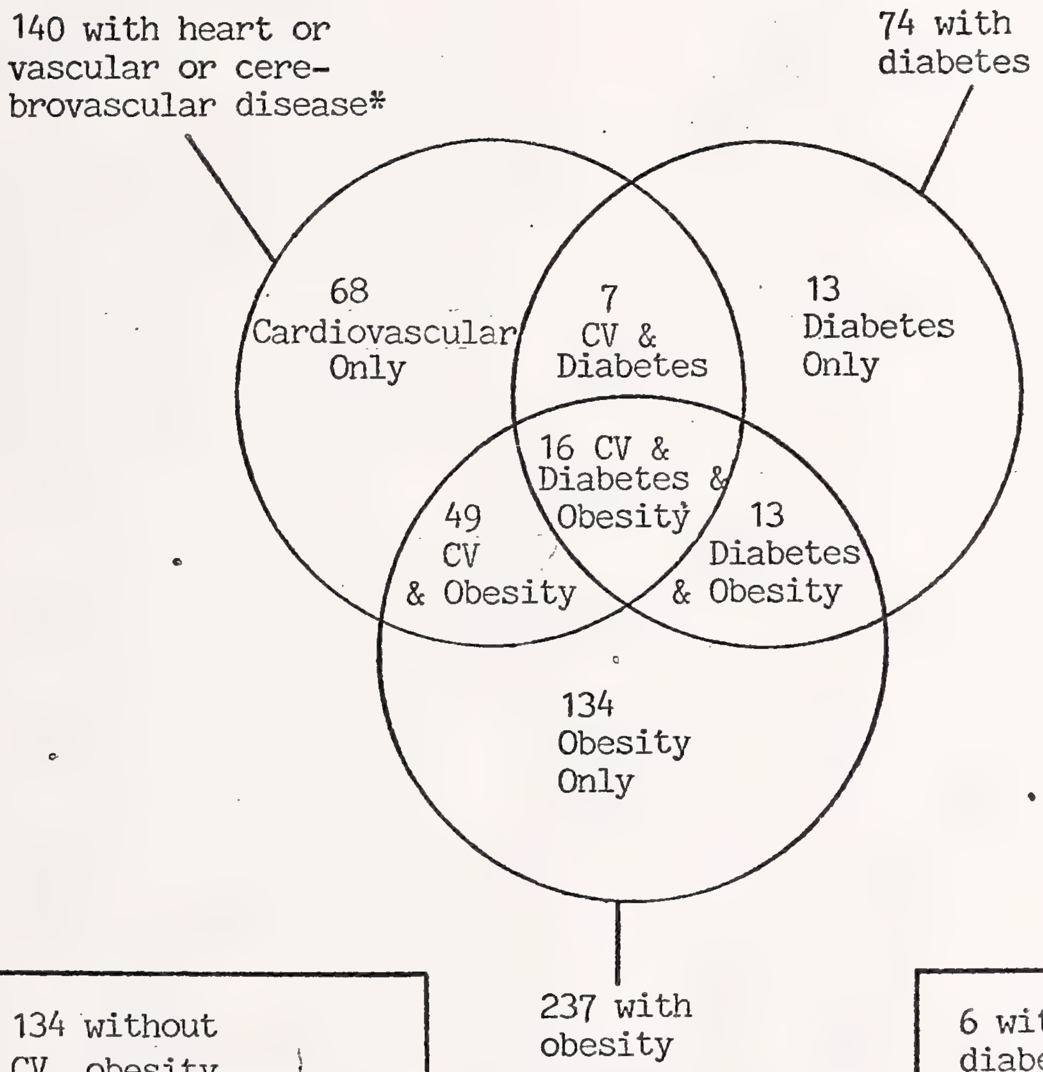
LOG-LINEAR PARAMETERS DIVIDED BY THEIR STANDARD ERRORS (BETA VALUES) FOR ALL RELATIONSHIPS WITH P < .05 - NEW EPISODES

Bundle	1966-70	1971-73	Heart, Diabetes or Obesity Comorbidity	No Heart, Obesity Or Diabetes Comorbidity
1	2.463*(1.228)	-2.463*(.815)	4.296***(1.430)	-4.296***(.699)
2-9	No significant relationships found for bundles 2-9.			

* - $p \leq .05$
** - $p \leq .01$
***- $p \leq .001$

FIGURE 7-1

465 Eisodes of Confirmed Hypertension



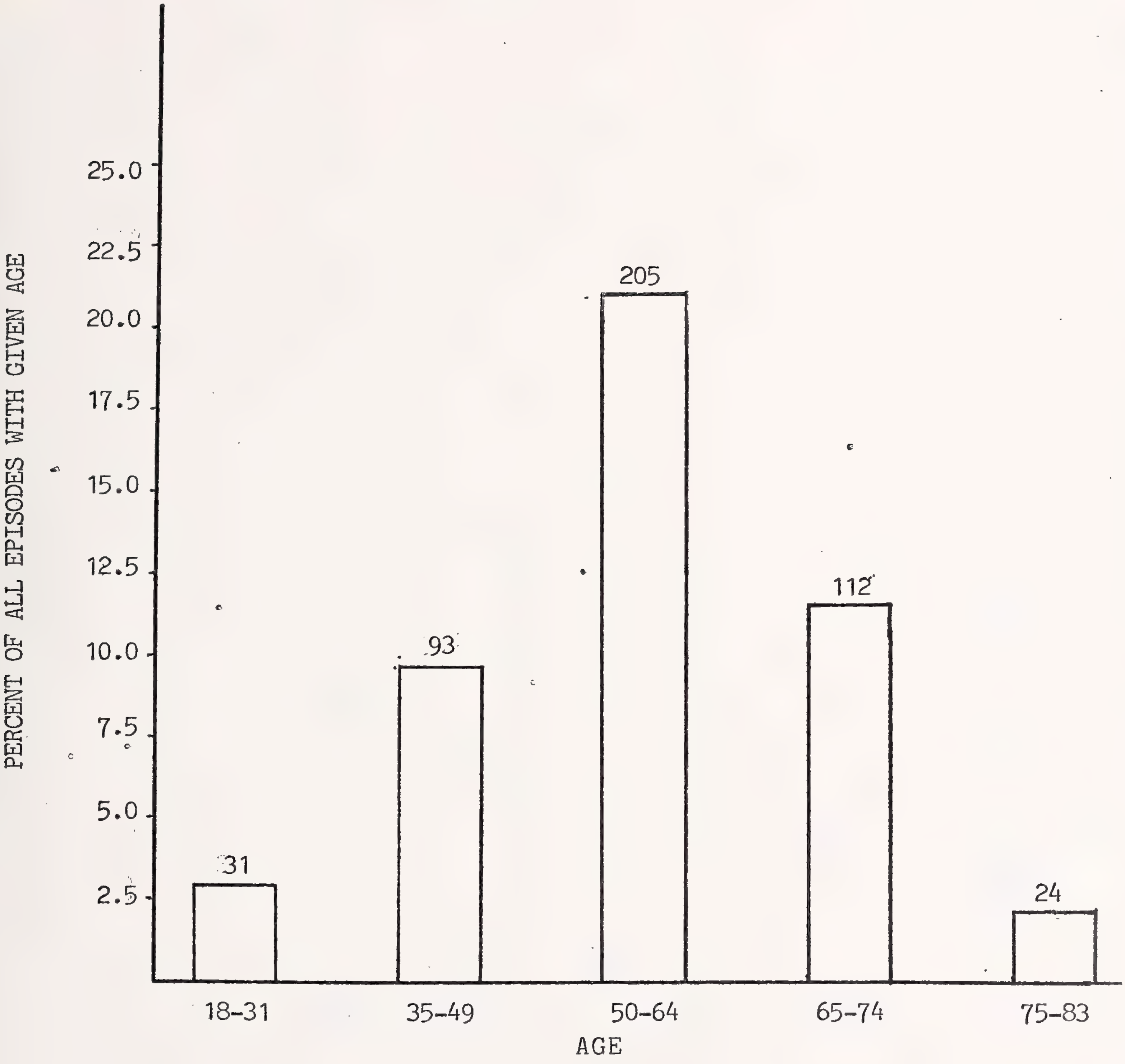
134 without CV, obesity, diabetes, renal, contraceptive, or pregnancy comorbidity. May have gout or drug adverse effect.

6 without CV, diabetes, or obesity comorbidity, but with renal, contraceptive, or pregnancy comorbidity.

*Referred to as cardiovascular or CV disease.

FIGURE 7-2

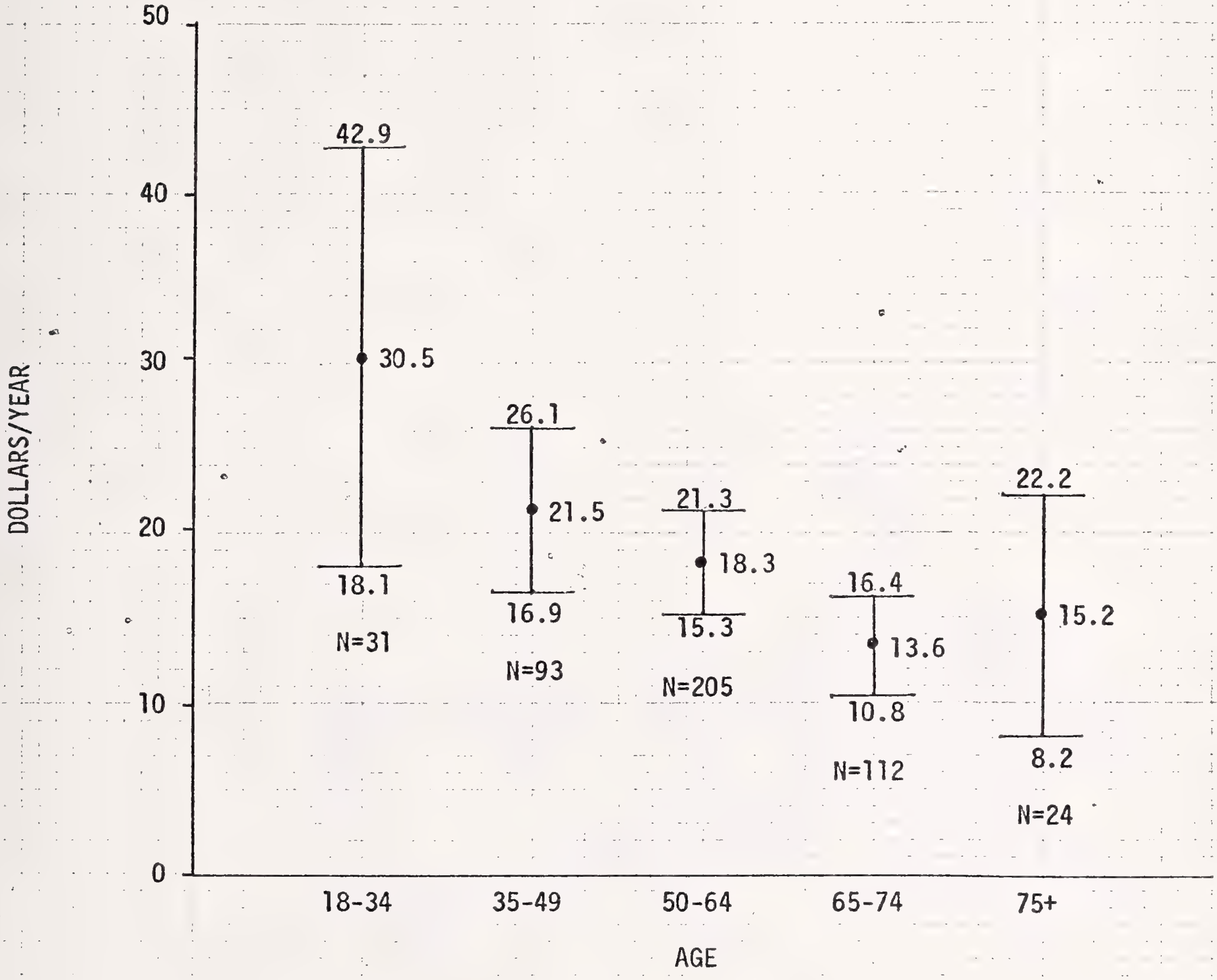
Age Distribution of Hypertensives



Mean 56.2
S.E. 0.6
Median 56.8
Range 19-83 Yrs.

FIGURE 7-3

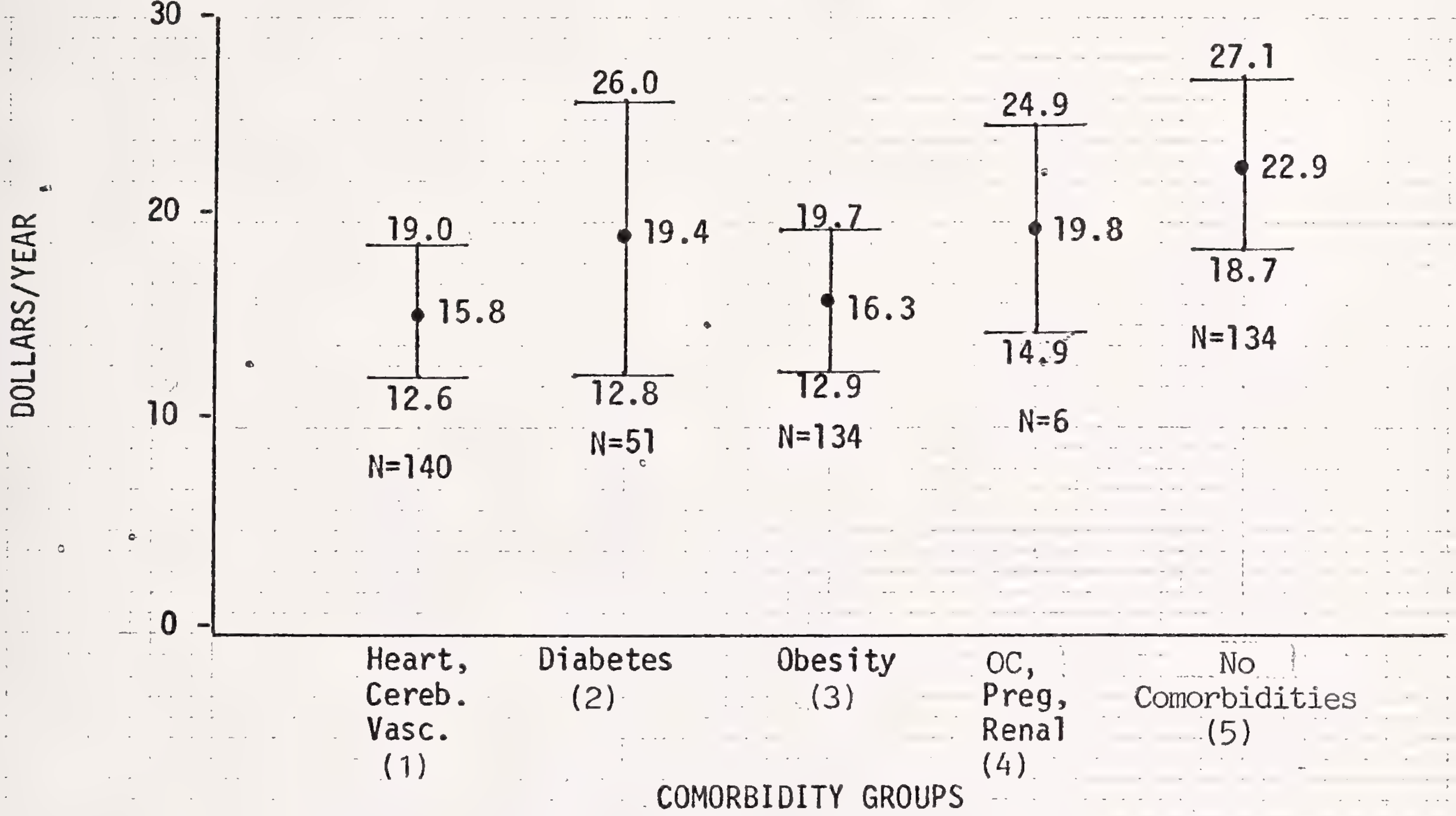
Mean Costs ($\pm$ 2 S.E.) Per Hypertension Episode Year
By Age at Index Contact



F = 4.7
P = .0011
ETA2 = .04

FIGURE 7-4

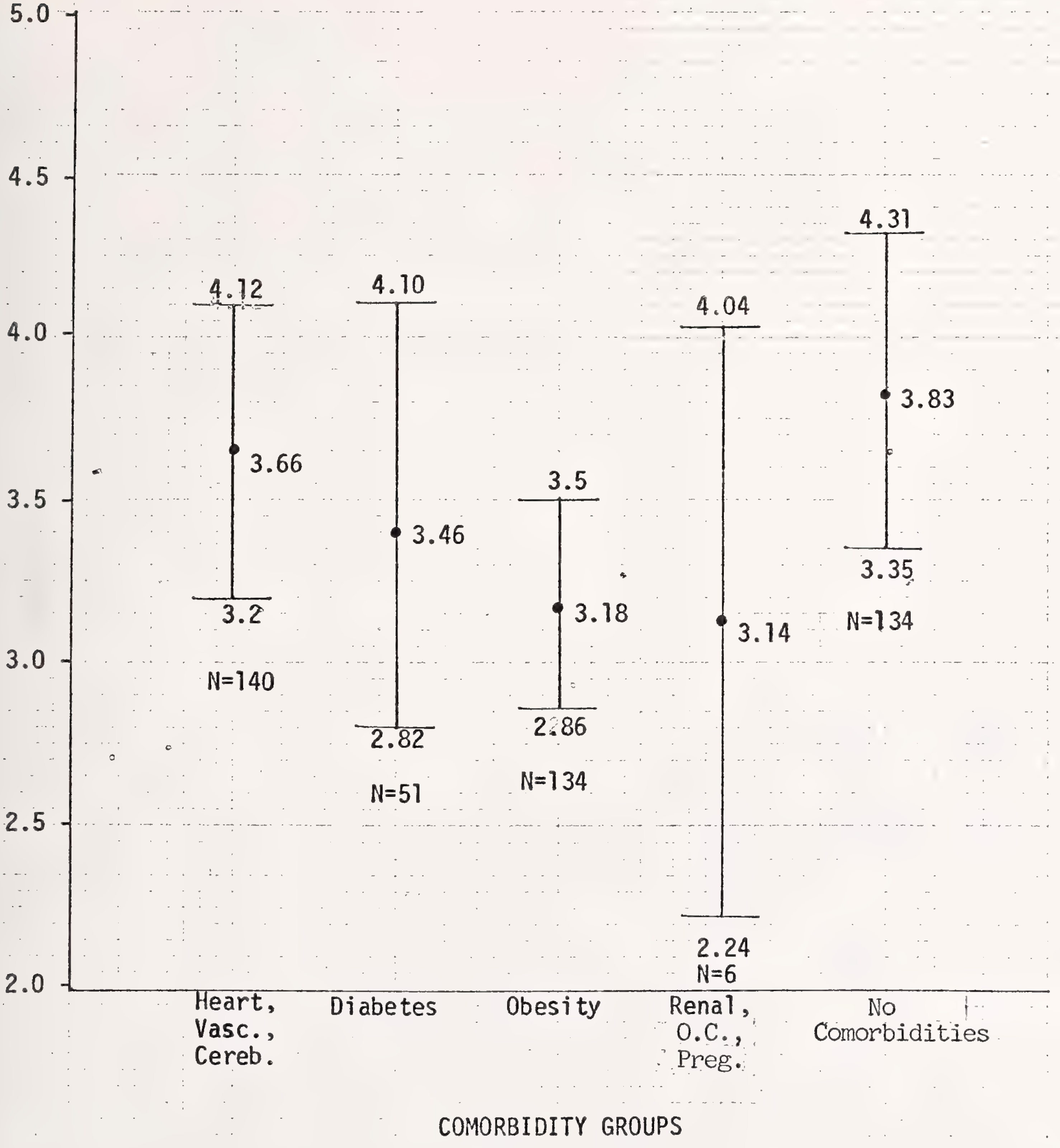
Mean Costs (± 2 S.E.) Per Hypertension Episode Year by Comorbidity Group



F = 2.4
P = 0.048
ETA^2 = 0.02

FIGURE 7-5

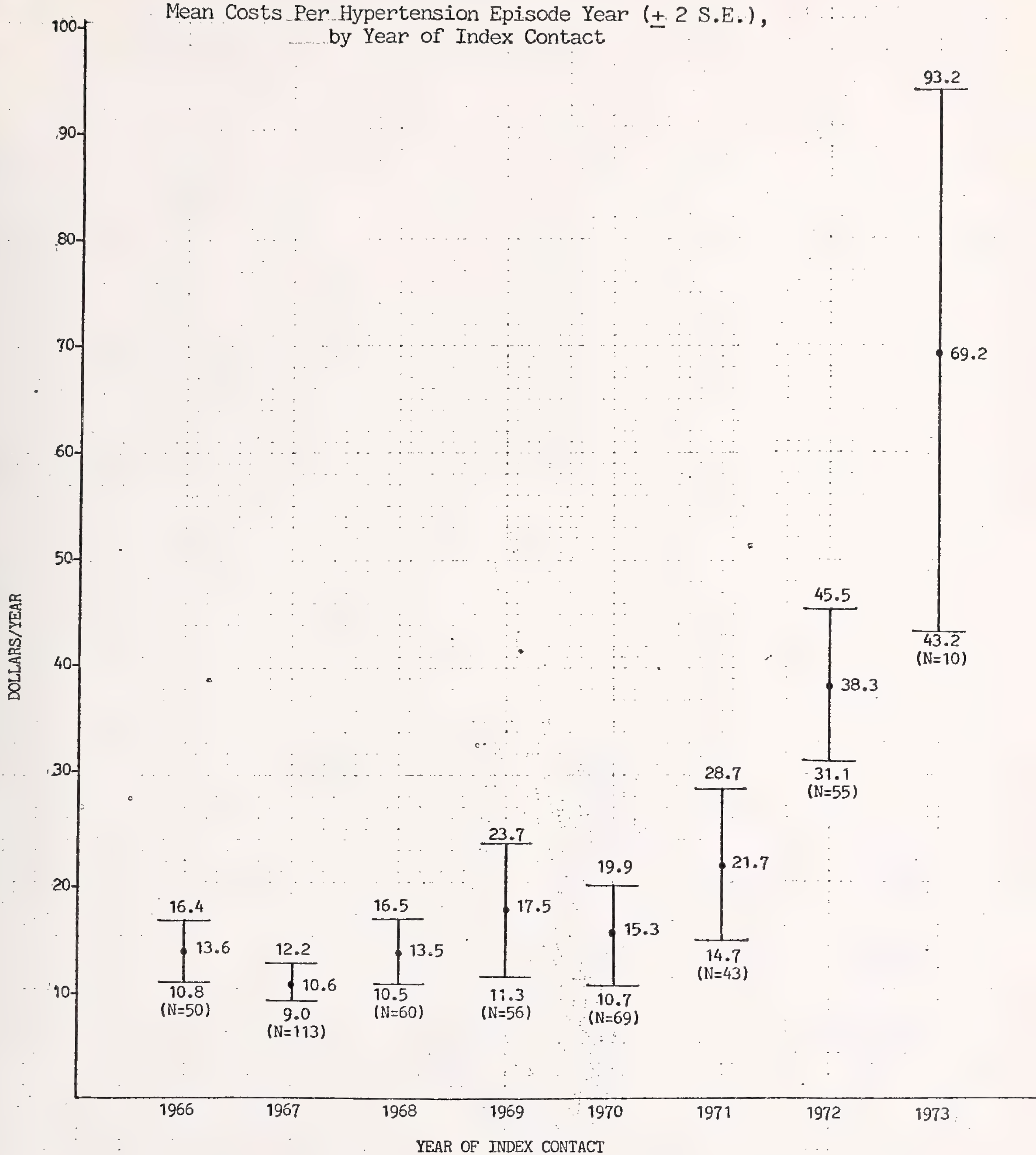
Mean Hypertension Medical Office Contacts Per Year (+ 2 S.E.) by Comorbidity Group



F = 1.3
P = .27
ETA2 = .01

FIGURE 7-6

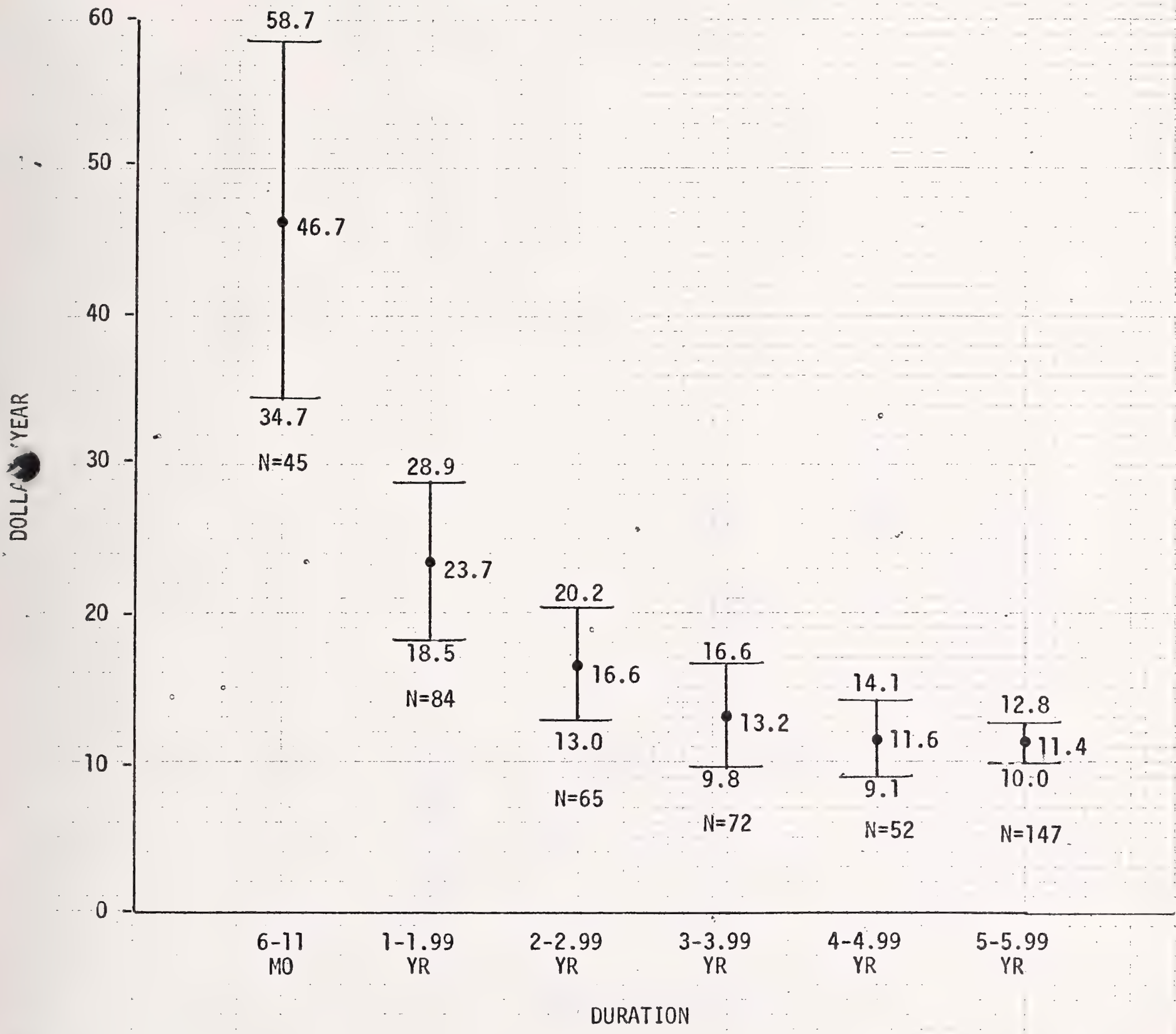
Mean Costs Per Hypertension Episode Year (± 2 S.E.), by Year of Index Contact



F = 24.7
P = <.0001
ETA^2 = .27

FIGURE 7-7

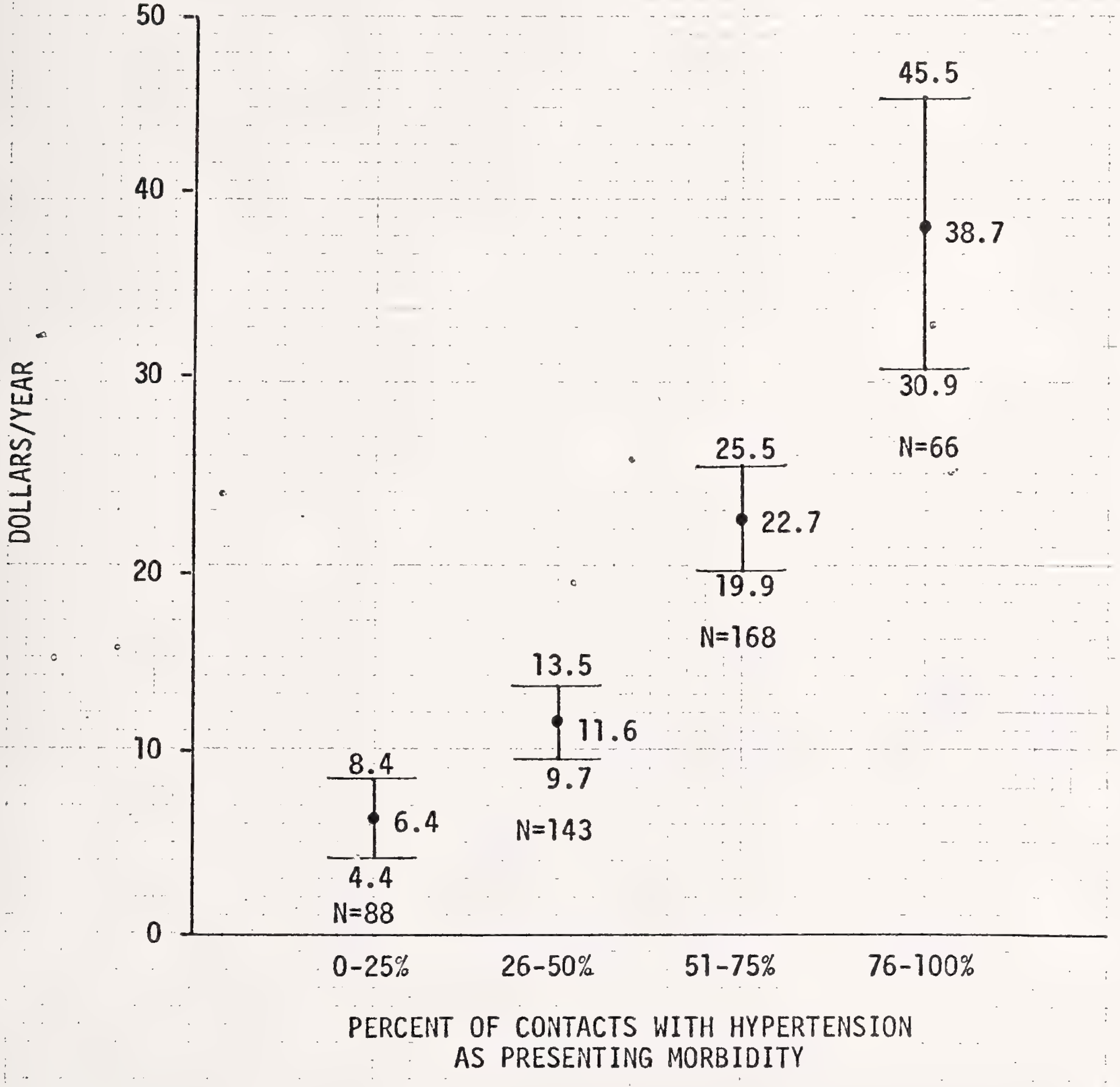
Mean Cost Per Hypertension Episode Year (± 2 S.E.)
by Episode Duration



$F = 29.8$
$P = < .0001$
$ETA^2 = .24$

FIGURE 7-8

Mean Costs ($\pm$ 2 S.E.) Per Hypertension Episode Year by Proportion of Contacts in Episode with Hypertension as Presenting Morbidity



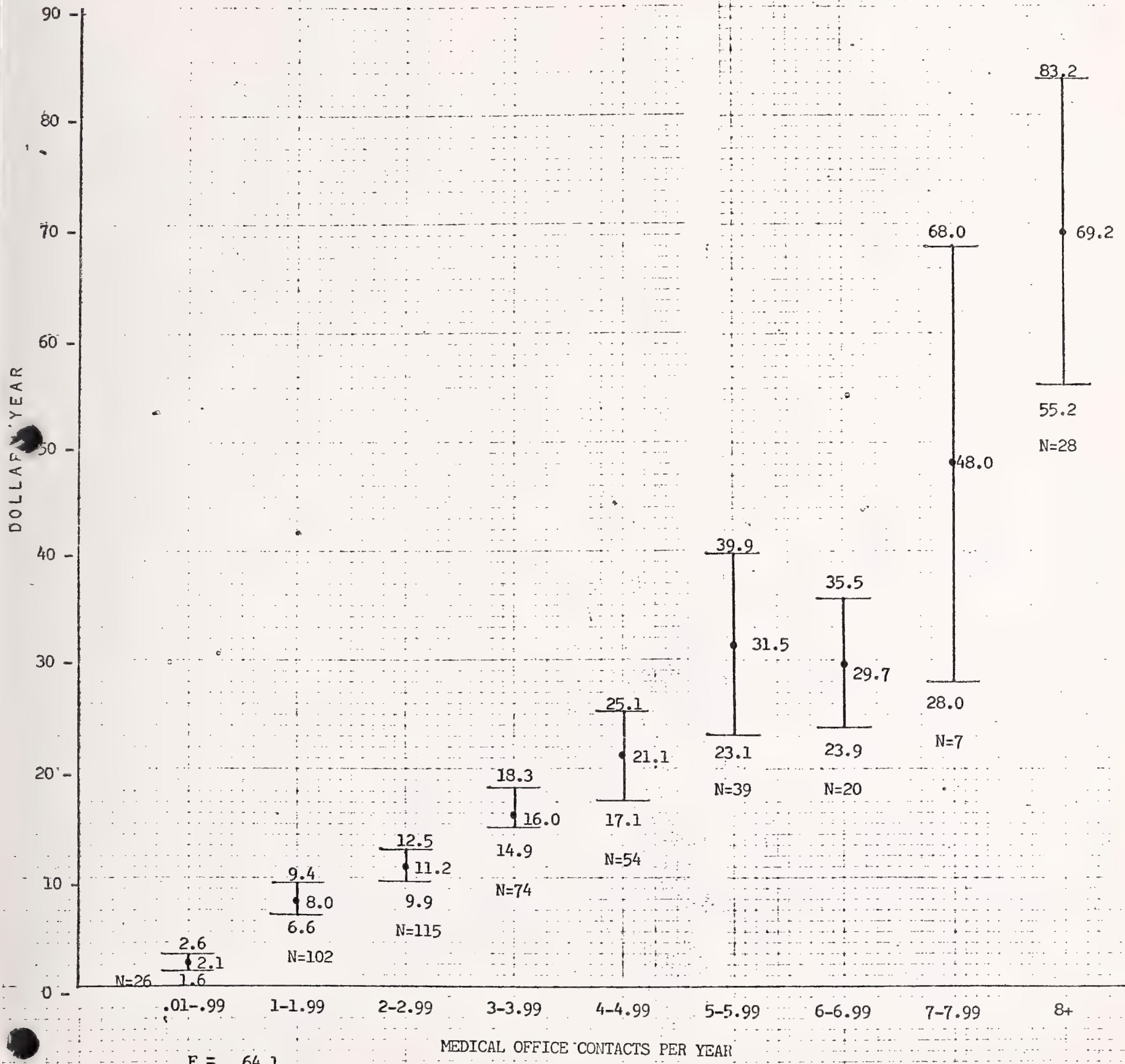
$F = 45.5$

$P = <.0001$

$ETA^2 = .23$

FIGURE 7-9

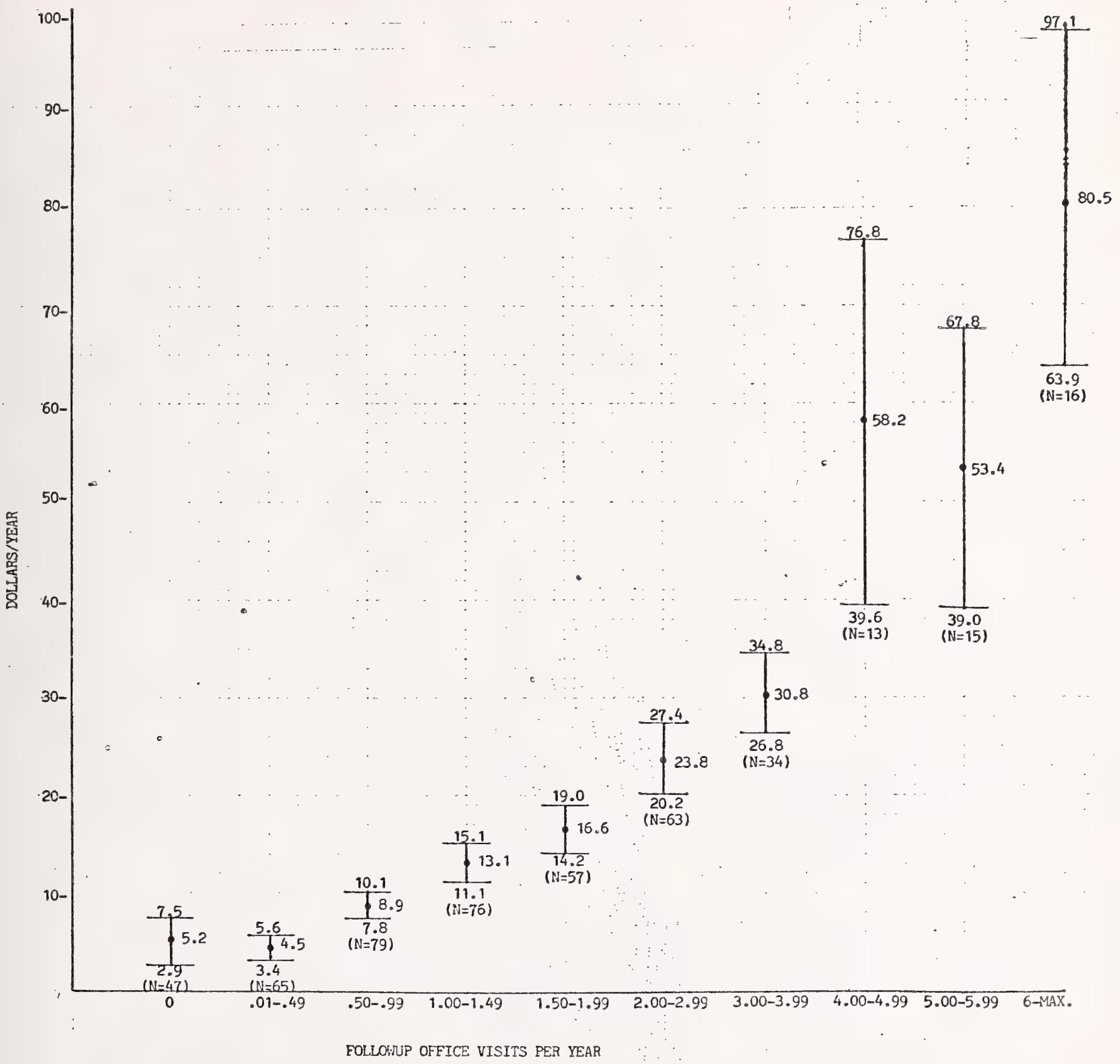
Mean Costs (+ 2 S.E.) Per Hypertension Episode Year by medical Office Contacts per Year



F = 64.1
P = .0001
ETA^2 = .53

FIGURE 7-10

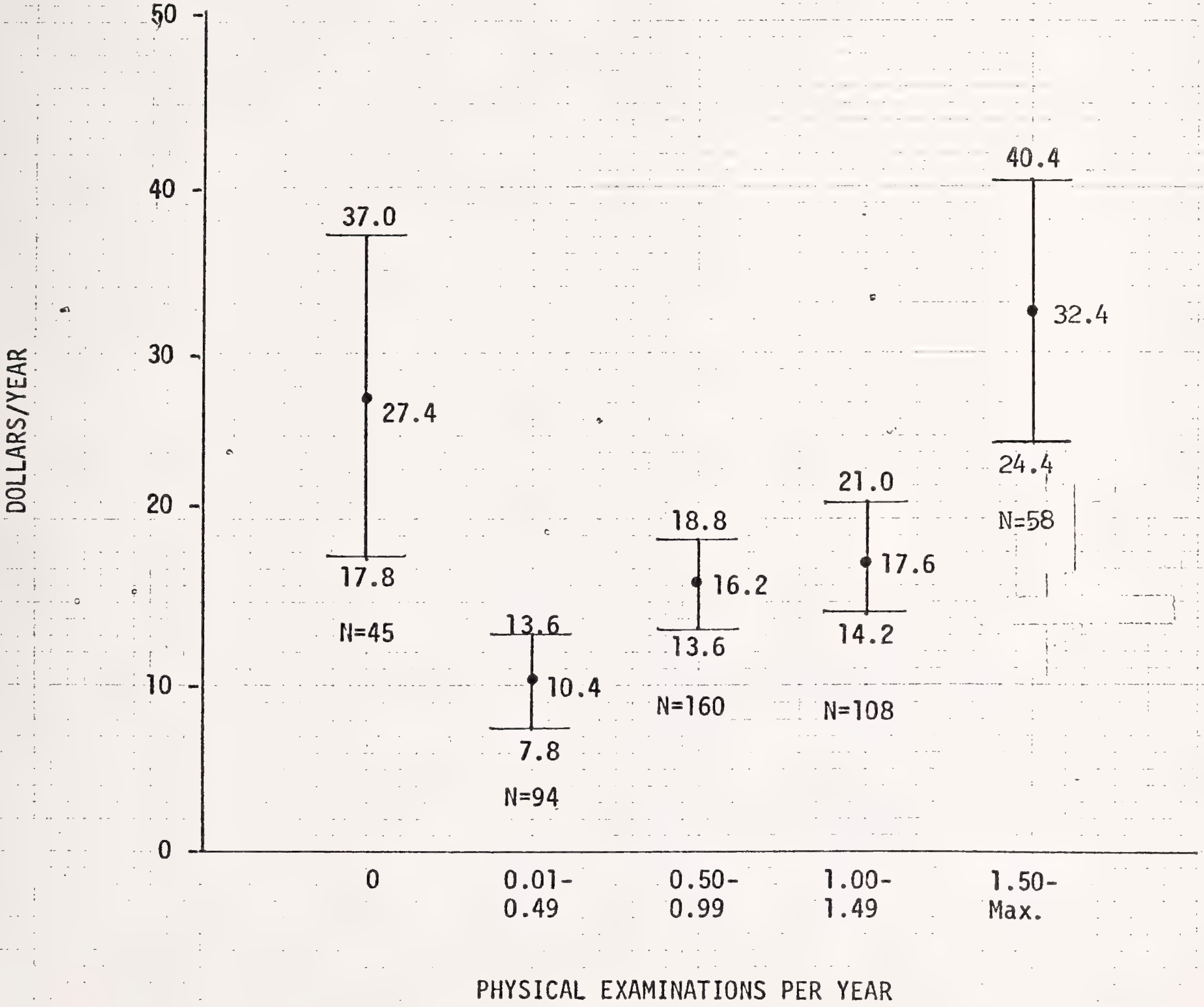
Mean Costs ($\pm$ 2 S.E.) Per Year, By Followup Office Visits Per Year for Hypertension



$F = 92.7$
$P = .0001$
$\text{ETA}^2 = .65$

FIGURE 7-11

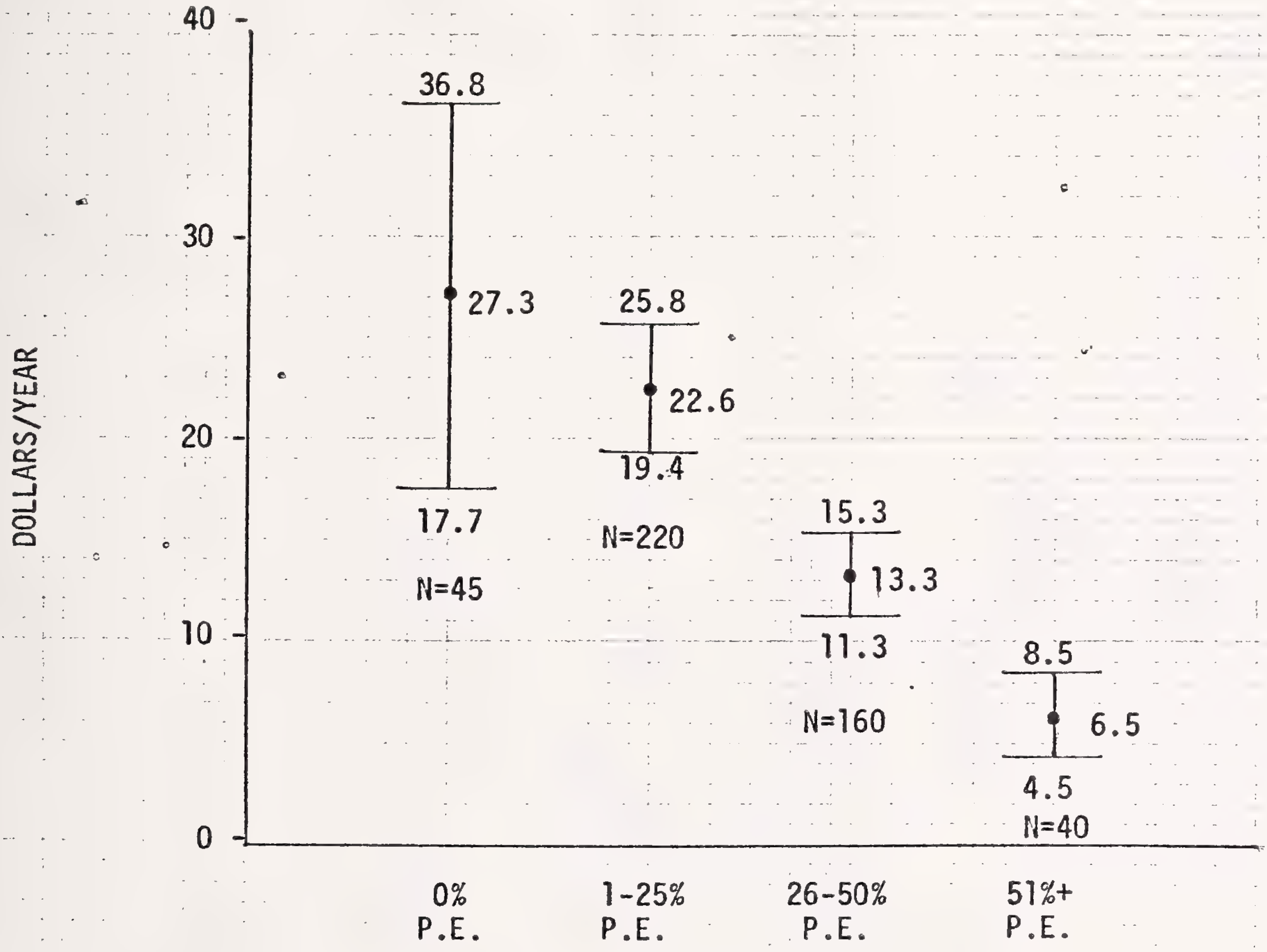
Mean Costs (± 2 S.E.) Per Year for Hypertension by the Mean Number of Physical Examinations Per Year



F = 13.2
P = .0001
ETA^2 = .10

FIGURE 7-12

Mean Costs (± 2 S.E.) Per Year for Hypertension by the Proportion of Contacts in the Episode that are Physical Examinations

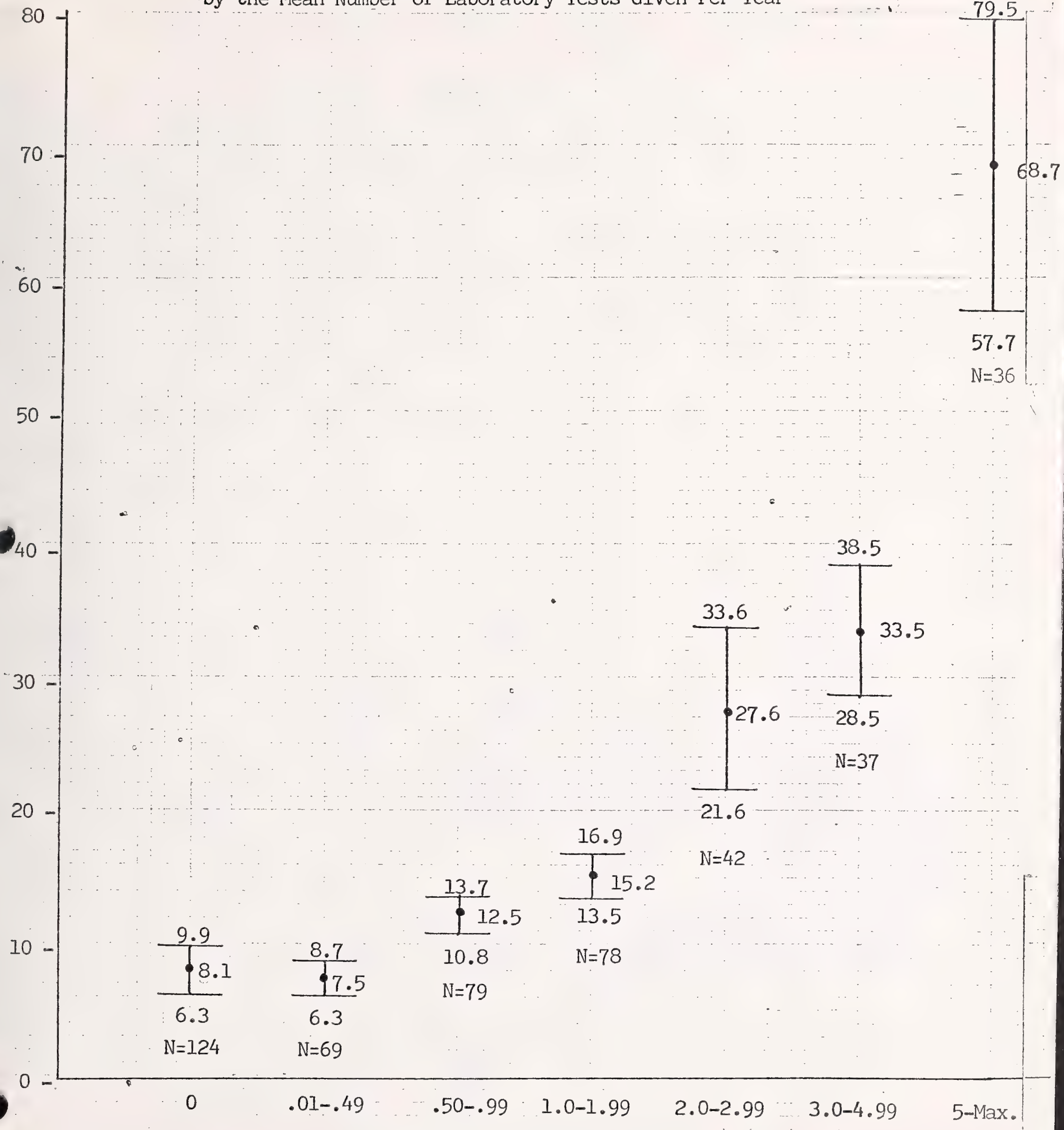


PERCENT OF CONTACTS THAT WERE PHYSICAL EXAMINATIONS

F = 13.6
P = .0001
ETA^2 = .08

FIGURE 7-13

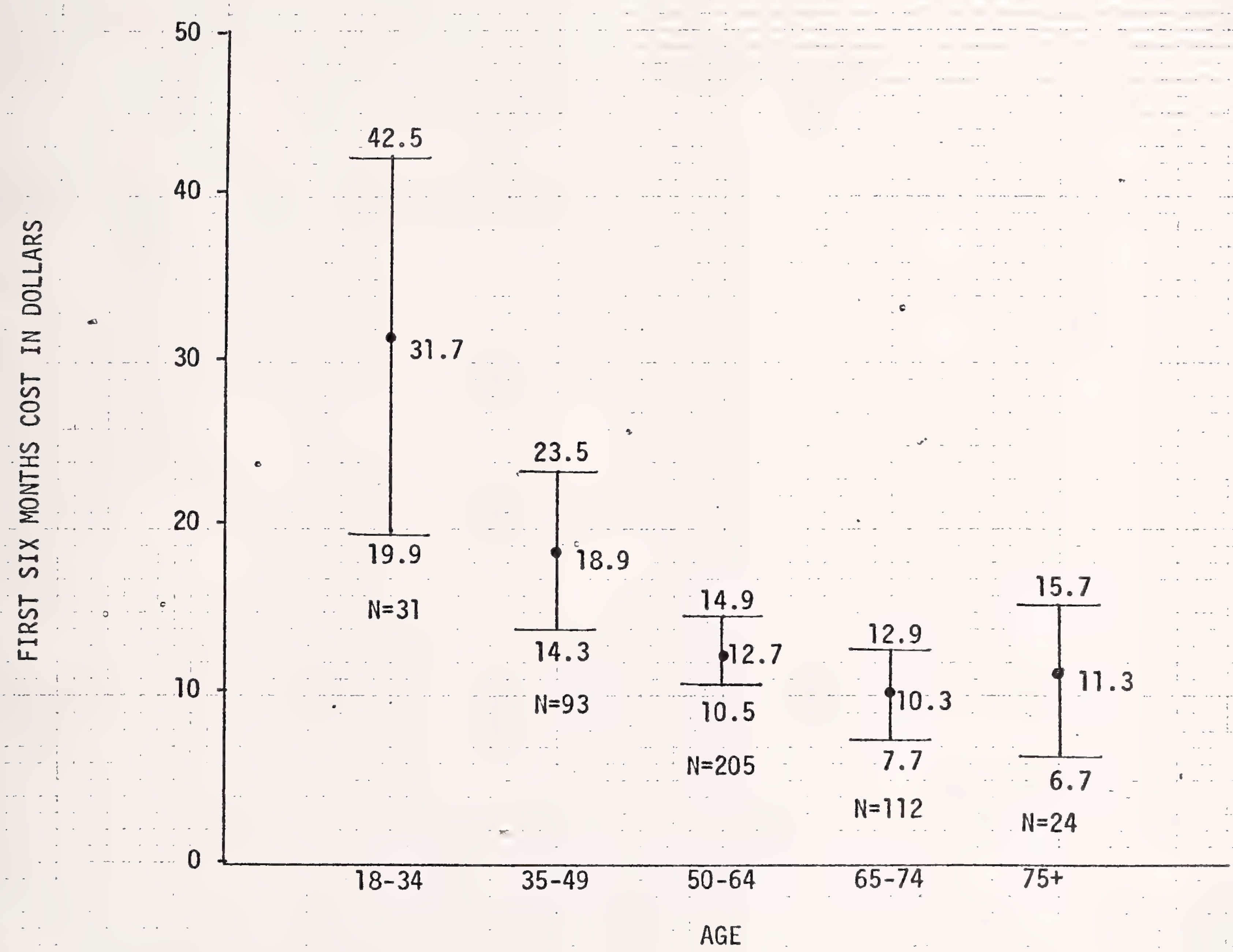
Mean Costs (+ 2 S.E.) Per Year for Hypertension by the Mean Number of Laboratory Tests Given Per Year



F = 10.7
P = .0001
ETA^2 = .09

FIGURE 7-14

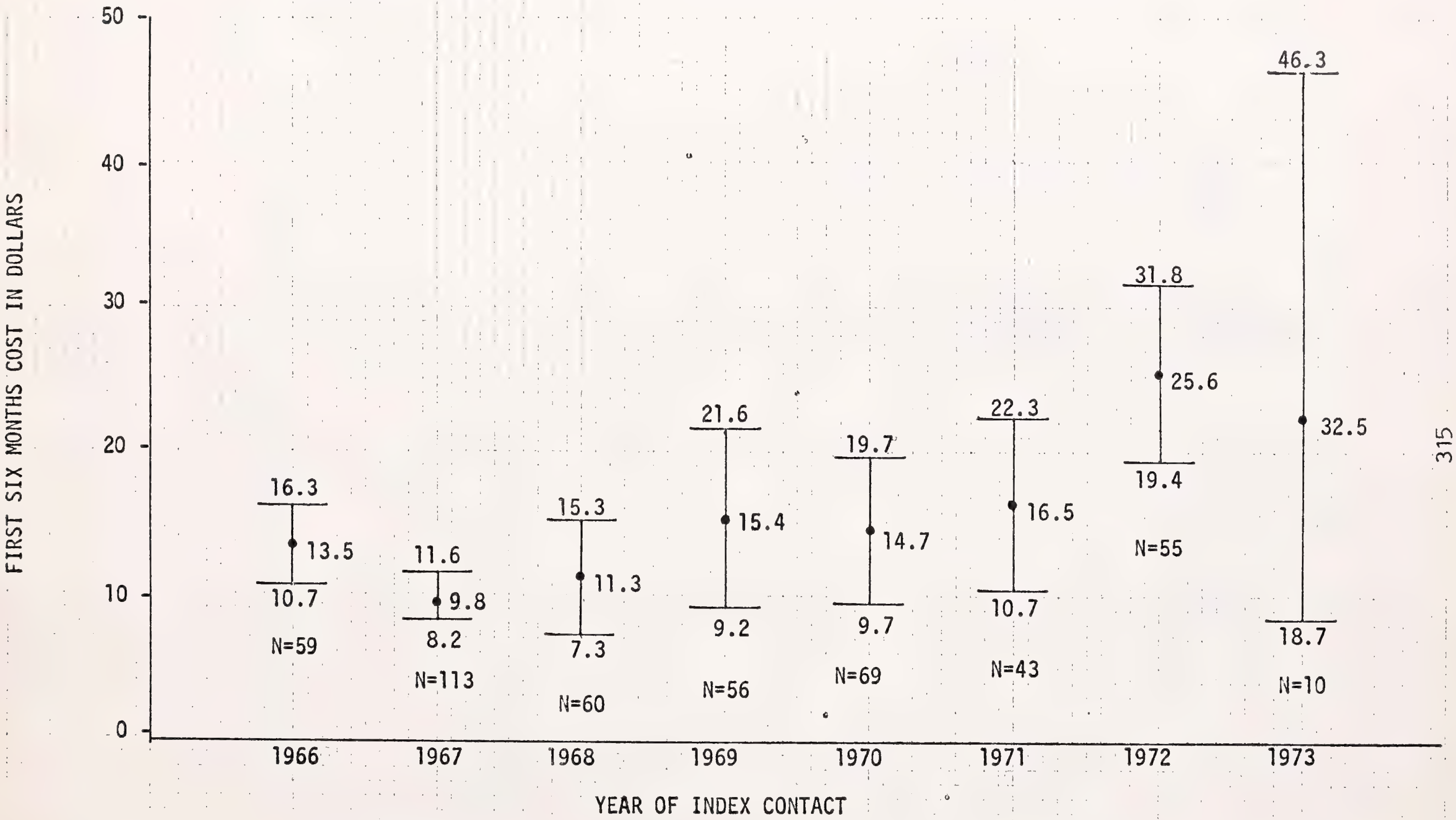
Mean Workup Costs (+ 2 S.E.) for Hypertension
by Age at Index Contact



F = 10.7
P = .0001
ETA^2 = .09

FIGURE 7-15

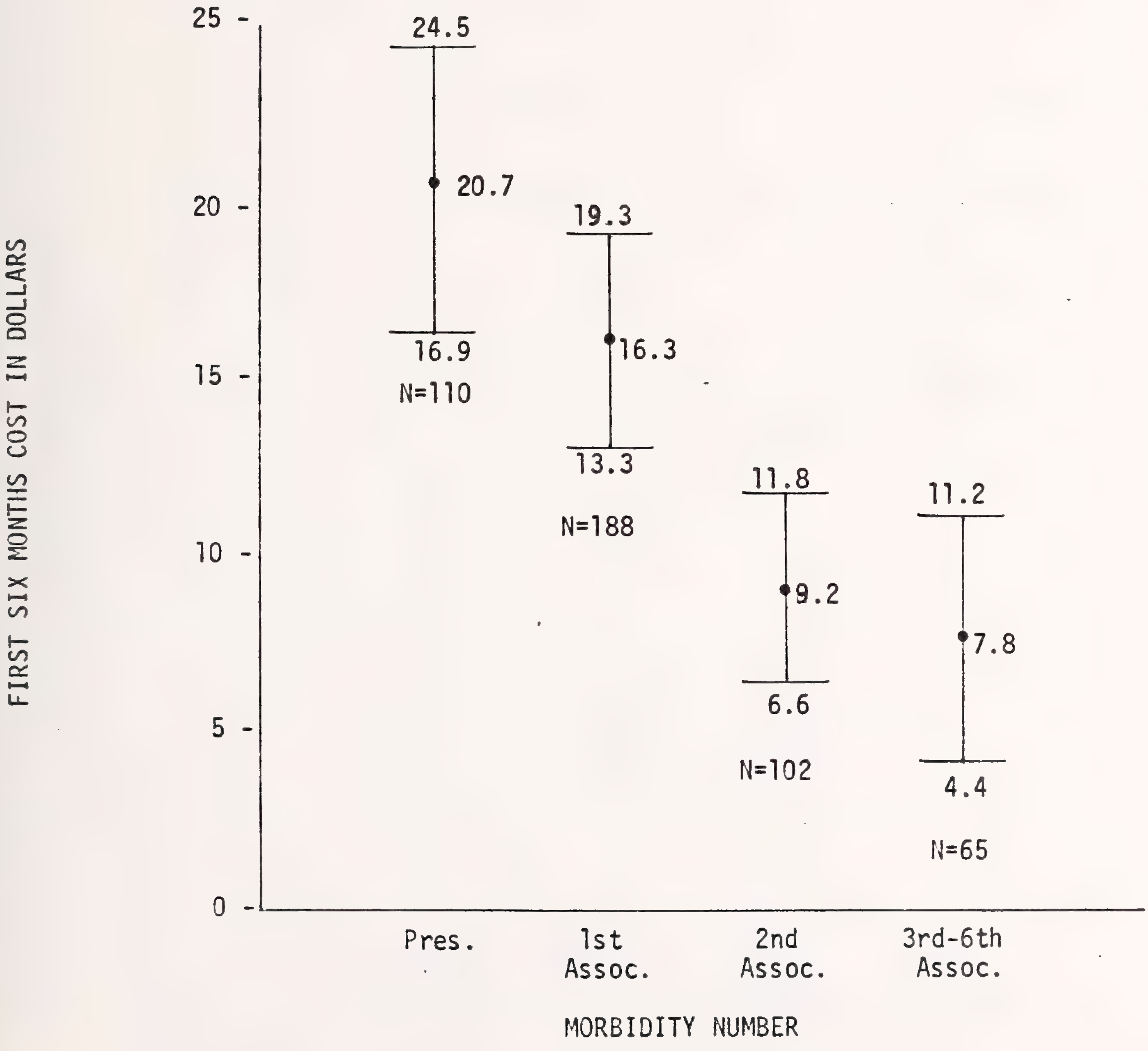
Mean Workup Costs (± 2 S.E.) for Hypertension by Year of Index Contact



F = 6.1
P = .0001
ETA^2 = .09

FIGURE 7-16

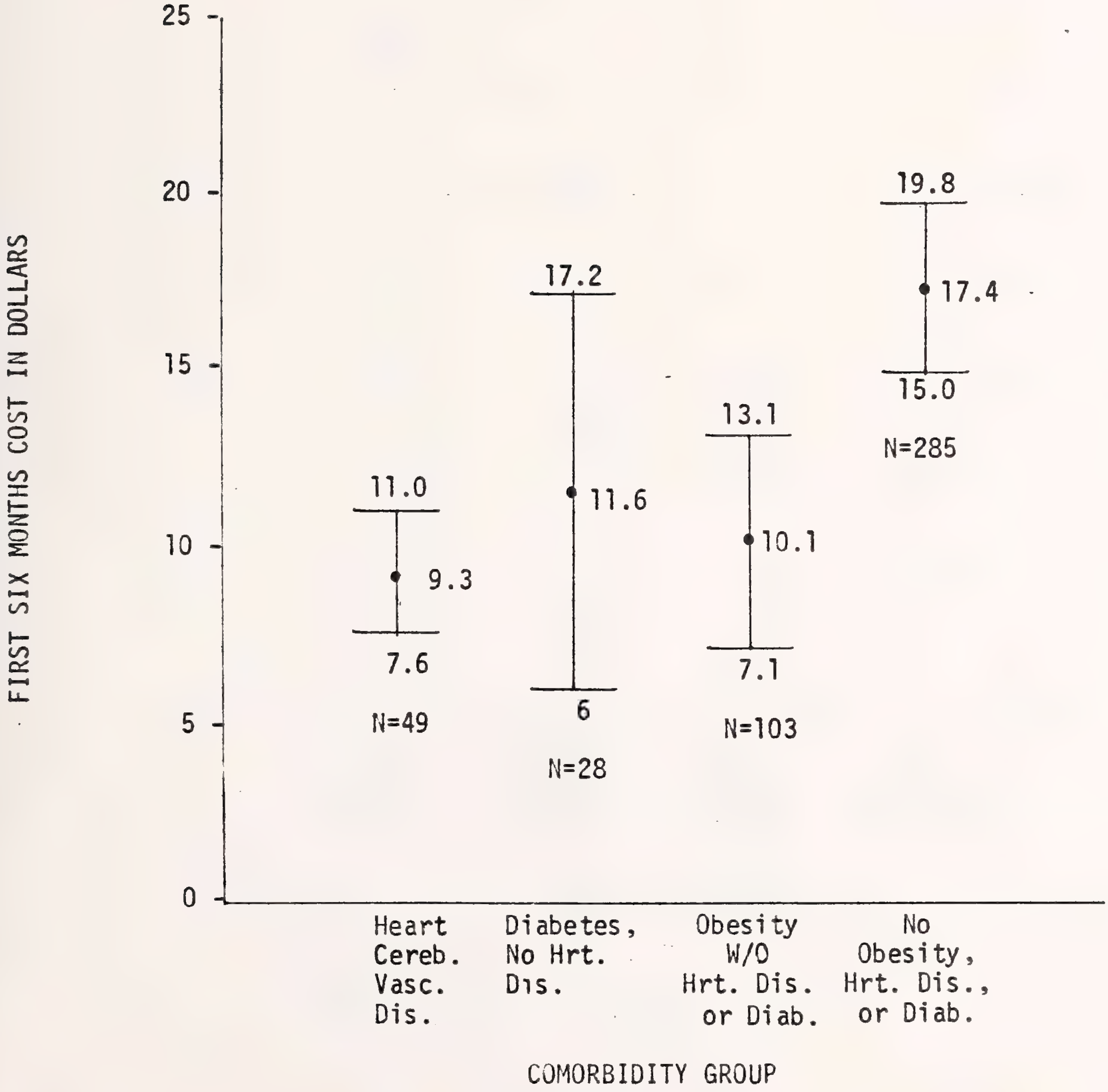
Mean Workup Costs ($\pm$ 2 S.E.) for Hypertension
by Morbidity Number of Hypertension at the Index Contact



F = 10.7
P = .0001
ETA^2 = .07

FIGURE 7-17

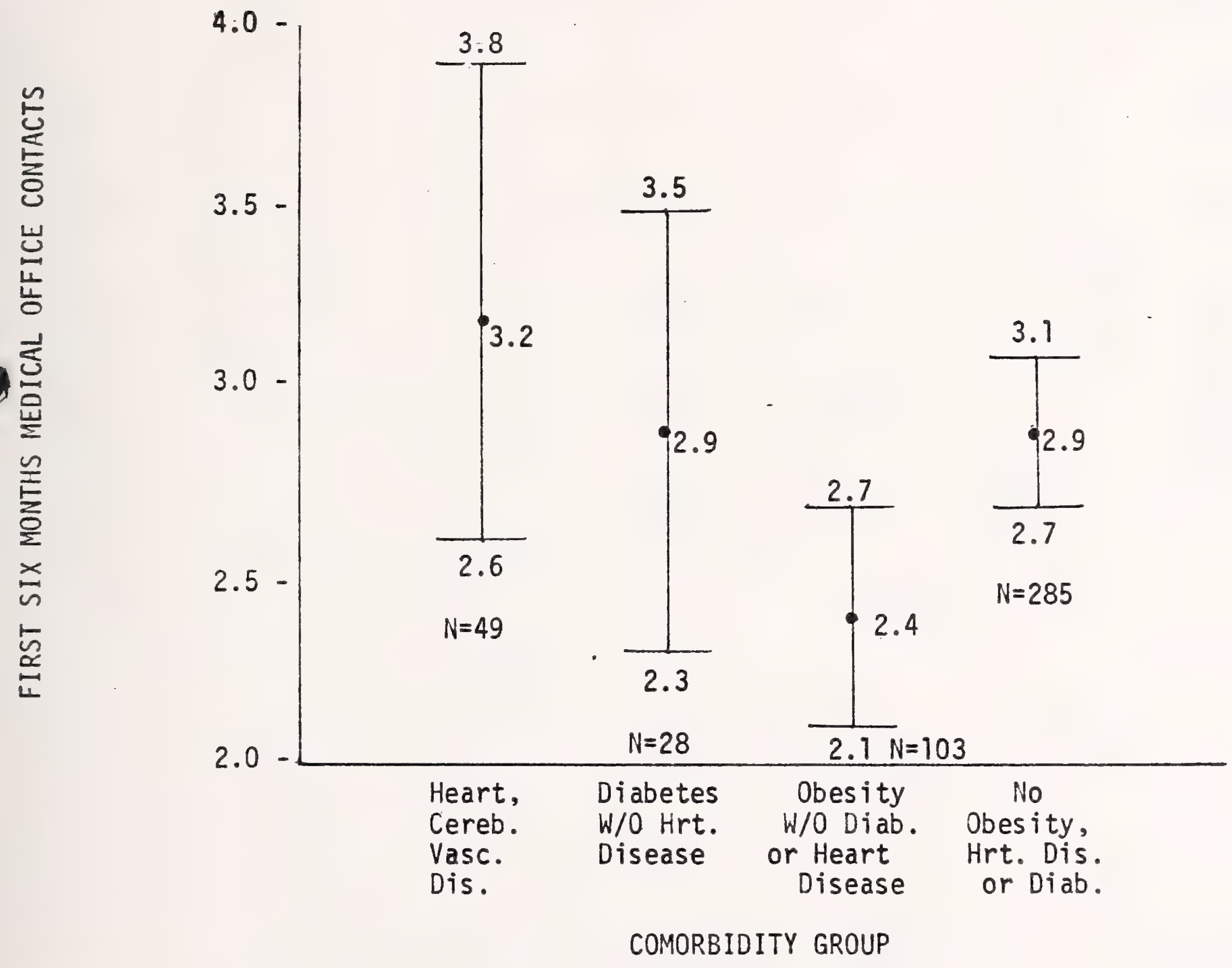
Mean Workup Costs (± 2 S.E.) for Hypertension by Comorbidity Group



F = 5.8
P = .0007
ETA^2 = .04

FIGURE 7-18

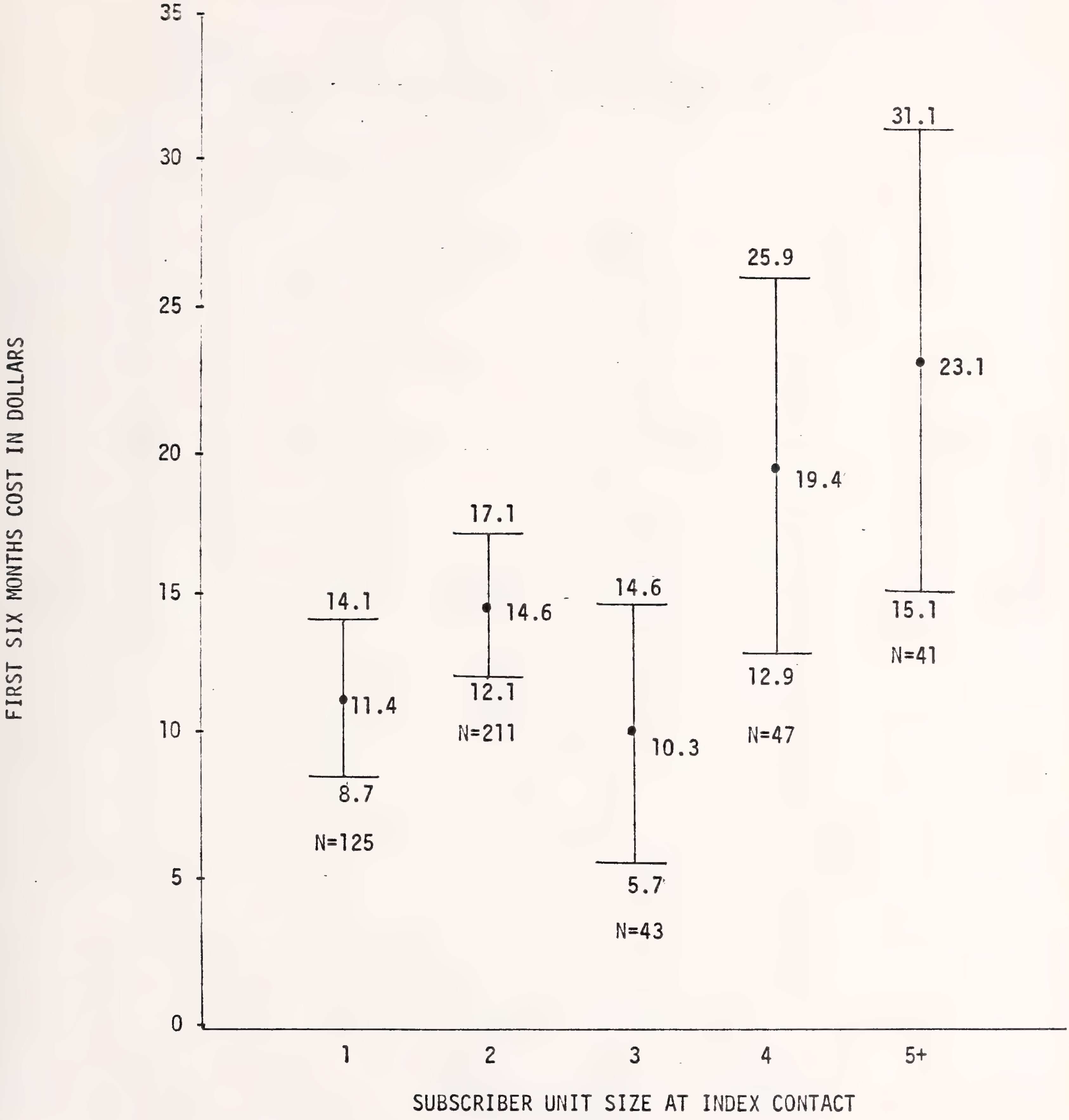
Mean Workup Medical Office Contacts (± 2 S.E.) for Hypertension by Comorbidity Group



F = 2.5
P = .06
ETA^2 = .02

FIGURE 7-19

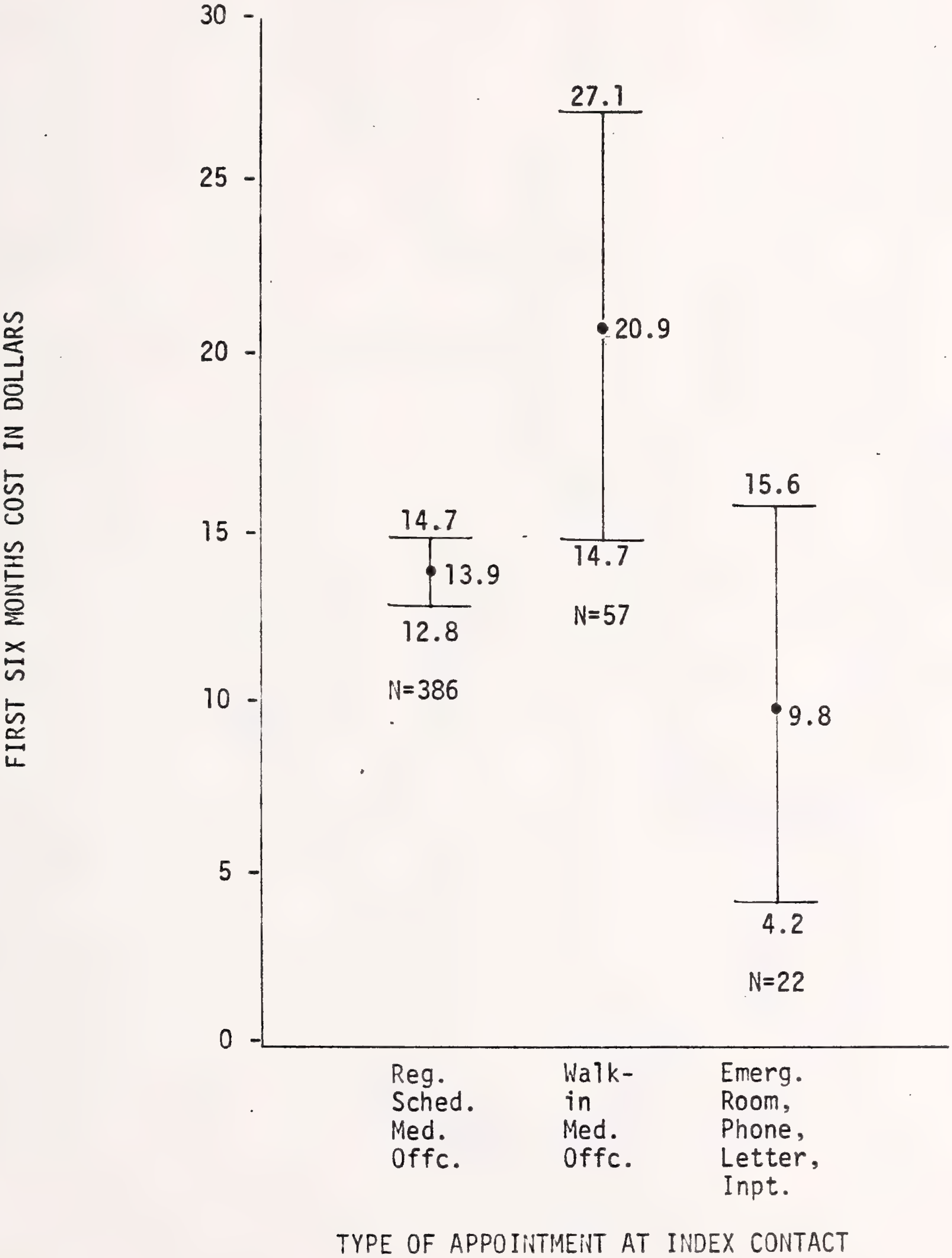
Mean Workup Period Costs (± 2 S.E.) for Hypertension
by Subscriber Unit Size at Index Contact



F = 4.5
P = .0013
ETA^2 = .04

FIGURE 7-20

Mean Workup Period Costs (± 2 S.E.) for Hypertension by Type of Appointment at Index Contact



F = 4.3
P = .014
ETA^2 = .02

FIGURE 7-21

A I D analysis for all 465 hypertension episodes; individual all-episode utilization measures are used to predict total dollar cost per episode year. Boxes contain number of cases (N), mean dollars per year ($\bar{Y}$), and standard deviation (S.D.) for episodes in each group. Parentheses contain percent of variation in parent group explained by each split. Brackets contain cumulative variation in entire population explained by all prior splits. Large numbers indicate terminations of bundle pathways in order of increasing mean dollar costs per year.

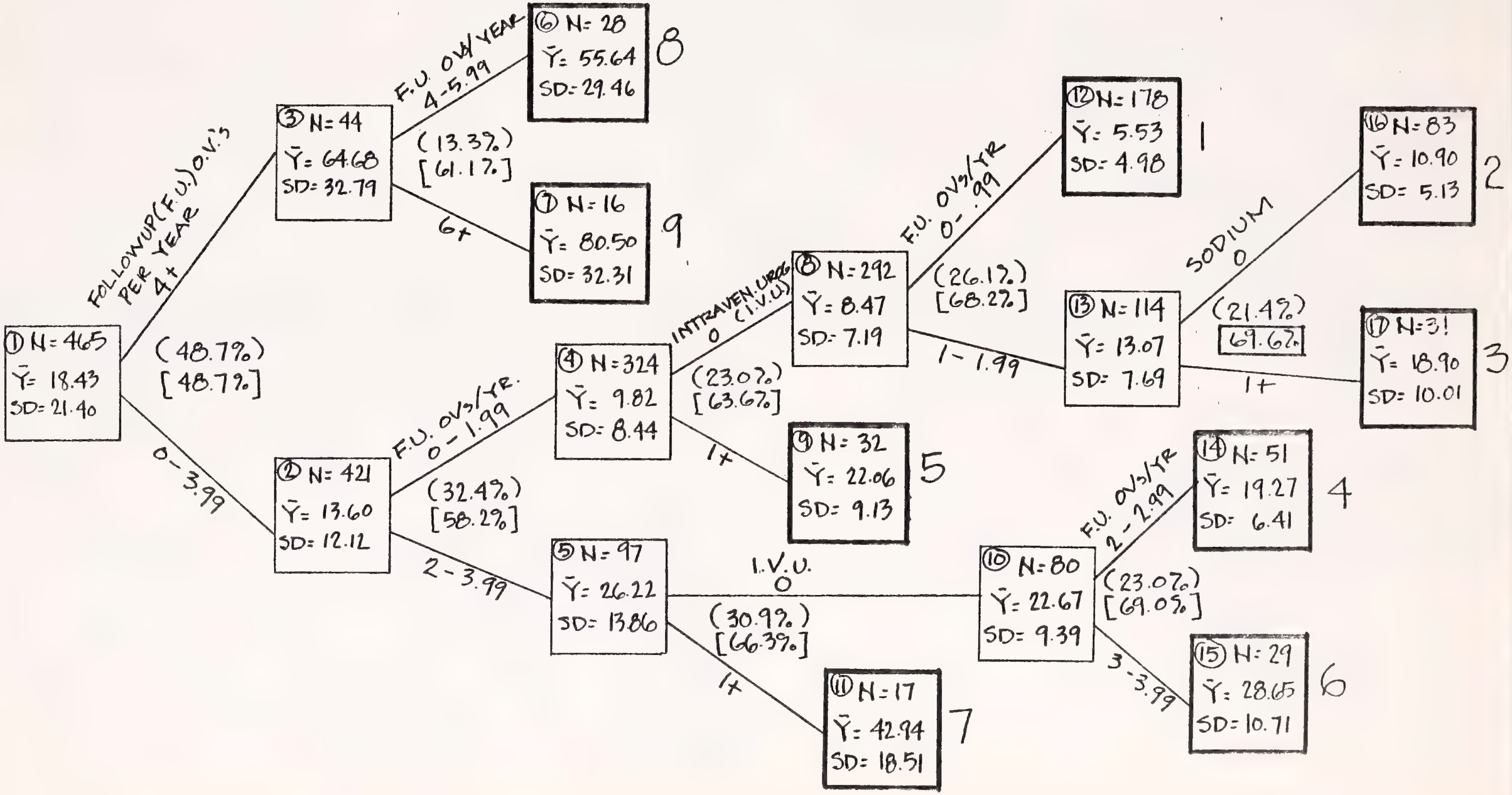
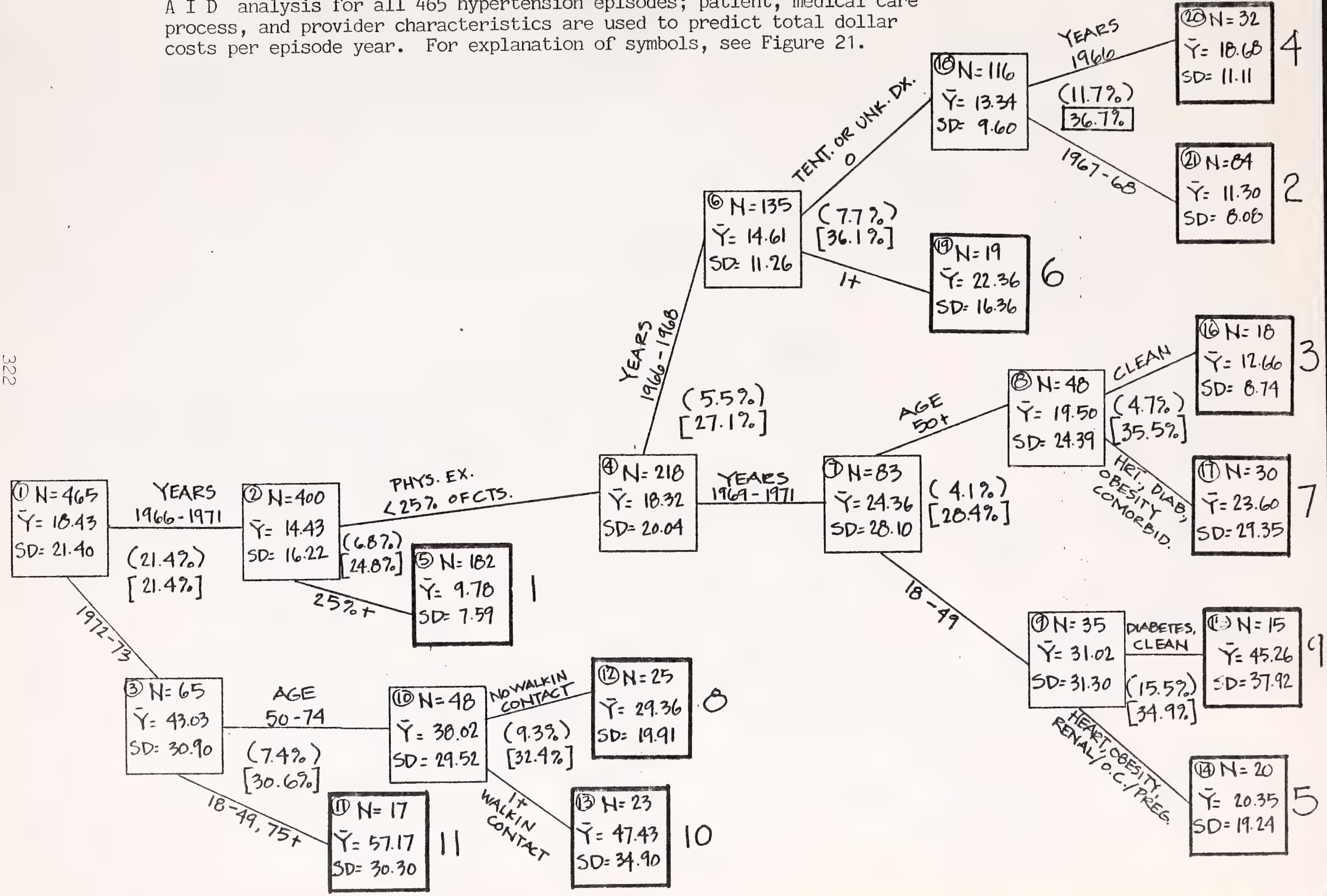


FIGURE 7-22

A I D analysis for all 465 hypertension episodes; patient, medical care process, and provider characteristics are used to predict total dollar costs per episode year. For explanation of symbols, see Figure 21.



① N=465 Ȳ= 18.43 SD= 21.40
YEARS 1966-1971
(21.4%) [21.4%]
1972-73
② N=400 Ȳ= 14.43 SD= 16.22
PHYS. EX. <25% OF CTS.
(6.8%) [24.8%]
25%+
⑤ N=182 Ȳ= 9.78 SD= 7.59
1
④ N=218 Ȳ= 18.32 SD= 20.04
YEARS 1966-1968
(5.5%) [27.1%]
YEARS 1969-1971
⑥ N=135 Ȳ= 14.61 SD= 11.26
TENT. OR UNK. DX. 0
(7.7%) [36.1%]
1+
⑱ N=116 Ȳ= 13.34 SD= 9.60
YEARS 1966
(11.7%) 36.7%
1967-68
⑳ N=32 Ȳ= 18.68 SD= 11.11
4
㉑ N=84 Ȳ= 11.30 SD= 8.08
2
⑲ N=19 Ȳ= 22.36 SD= 16.36
6
⑦ N=83 Ȳ= 24.36 SD= 28.10
AGE 50+
(4.1%) [28.4%]
18-49
⑧ N=48 Ȳ= 19.50 SD= 24.39
CLEAN
(4.7%) [35.5%]
HET; DIAB; OBESITY COMORBID.
⑯ N=18 Ȳ= 12.66 SD= 8.74
3
⑰ N=30 Ȳ= 23.60 SD= 29.35
7
⑨ N=35 Ȳ= 31.02 SD= 31.30
DIABETES, CLEAN
(15.5%) [34.9%]
HEART, OBESITY, RENAL/O.C./PREG.
⑮ N=15 Ȳ= 45.26 SD= 37.92
9
⑭ N=20 Ȳ= 20.35 SD= 19.24
5
③ N=65 Ȳ= 43.03 SD= 30.90
AGE 50-74
(7.4%) [30.6%]
18-49, 75+
⑩ N=48 Ȳ= 38.02 SD= 29.52
NO WALKIN CONTACT
(9.3%) [32.4%]
1+ WALKIN CONTACT
⑫ N=25 Ȳ= 29.36 SD= 19.91
8
⑬ N=23 Ȳ= 47.43 SD= 34.90
10
⑪ N=17 Ȳ= 57.17 SD= 30.30
11

FIGURE 7-23

A I D analysis for 313 (new) hypertension episodes; individual utilization measures for the first six months of the episode are used to predict total dollar cost for the initial six-month workup period. For explanation of symbols, see Figure 21.

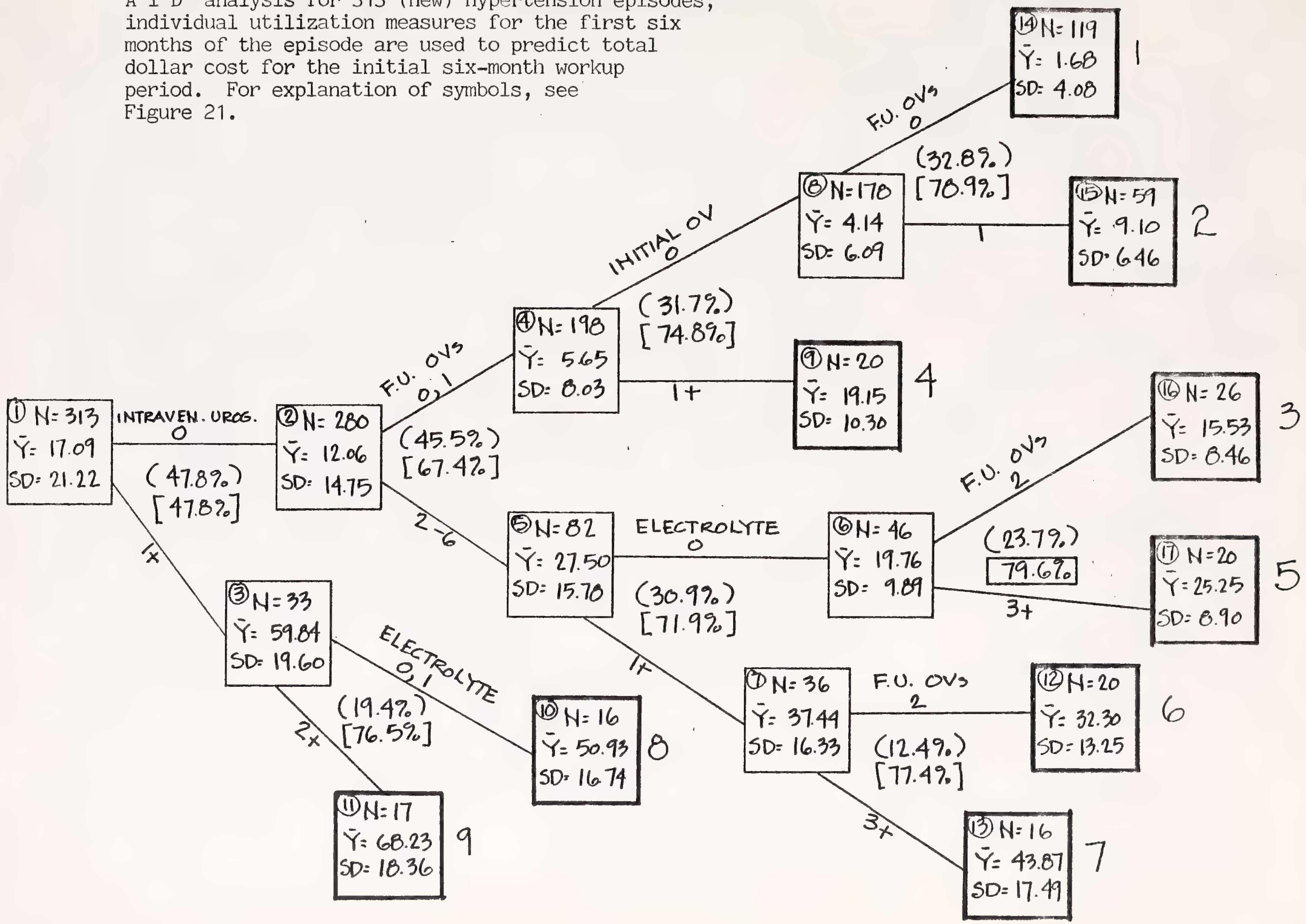
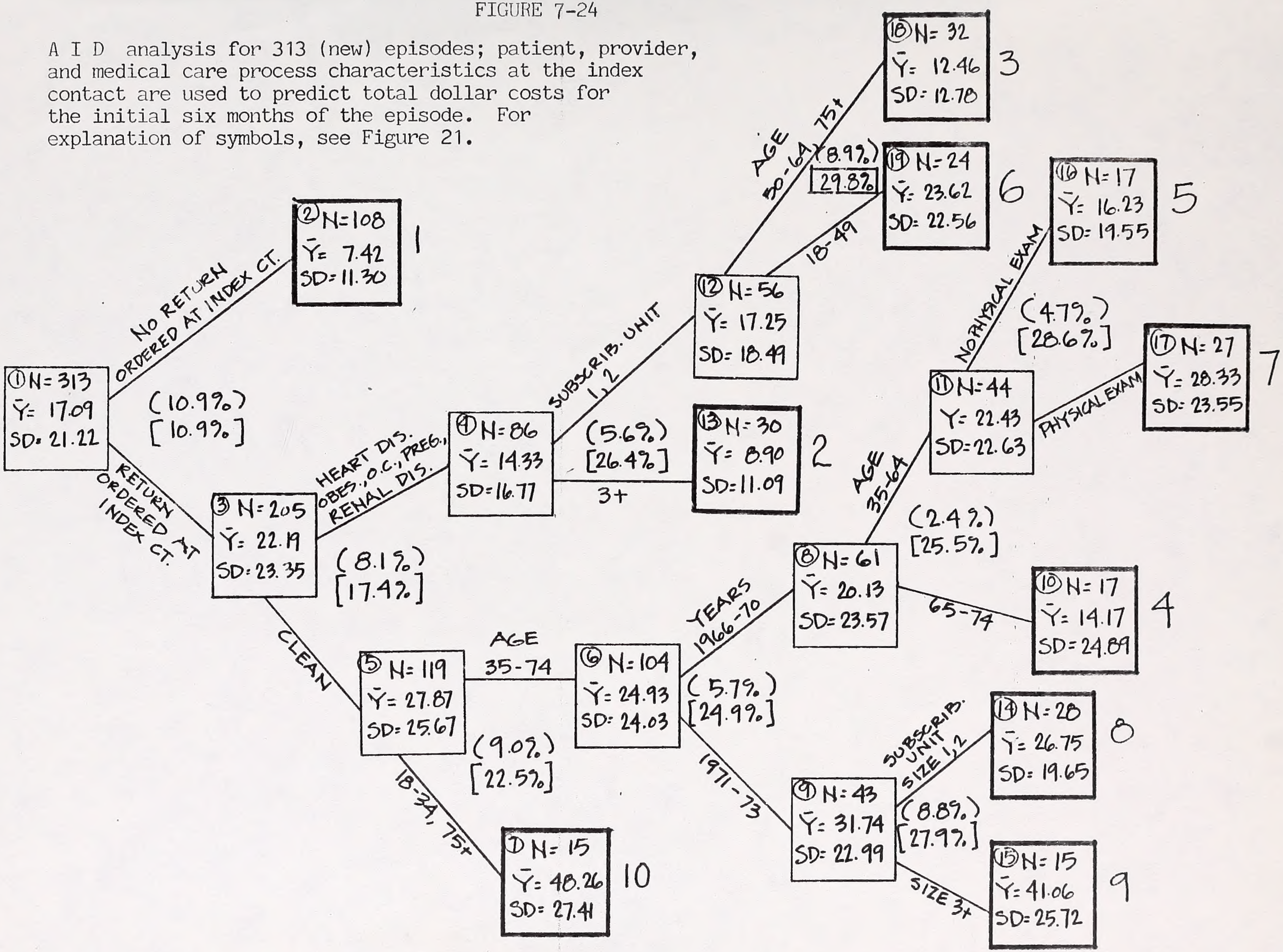


FIGURE 7-24

A I D analysis for 313 (new) episodes; patient, provider, and medical care process characteristics at the index contact are used to predict total dollar costs for the initial six months of the episode. For explanation of symbols, see Figure 21.



① N=313 Ȳ= 17.09 SD= 21.22
NO RETURN ORDERED AT INDEX CT.
(10.9%) [10.9%]
② N=108 Ȳ= 7.42 SD=11.30
1
RETURN ORDERED AT INDEX CT.
③ N=205 Ȳ= 22.19 SD=23.35
HEART DIS. OBES., O.C., PREG., RENAL DIS.
(8.1%) [17.4%]
④ N=86 Ȳ= 14.33 SD=16.77
SUBSCRIB. UNIT 1,2
(5.6%) [26.4%]
3+
⑫ N=56 Ȳ= 17.25 SD= 18.49
AGE 50-64, 75+
(8.9%) [29.8%]
18-49
⑱ N= 32 Ȳ= 12.46 SD= 12.78
3
⑲ N= 24 Ȳ= 23.62 SD= 22.56
6
⑬ N= 30 Ȳ= 8.90 SD=11.09
2
CLEAN
⑤ N= 119 Ȳ= 27.87 SD= 25.67
AGE 35-74
(9.0%) [22.5%]
18-34, 75+
⑦ N= 15 Ȳ= 48.26 SD= 27.41
10
⑥ N=104 Ȳ= 24.93 SD= 24.03
YEARS 1966-70
(5.7%) [24.9%]
1971-73
⑧ N= 61 Ȳ= 20.13 SD= 23.57
AGE 35-64
(2.4%) [25.5%]
65-74
⑩ N= 17 Ȳ= 14.17 SD= 24.89
4
⑪ N= 44 Ȳ= 22.43 SD= 22.63
NO PHYSICAL EXAM
(4.7%) [28.6%]
PHYSICAL EXAM
⑯ N= 17 Ȳ= 16.23 SD= 19.55
5
⑰ N= 27 Ȳ= 28.33 SD= 23.55
7
⑨ N= 43 Ȳ= 31.74 SD= 22.99
SUBSCRIB. UNIT SIZE 1,2
(8.8%) [27.9%]
SIZE 3+
⑭ N= 28 Ȳ= 26.75 SD= 19.65
8
⑮ N= 15 Ȳ= 41.06 SD= 25.72
9

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